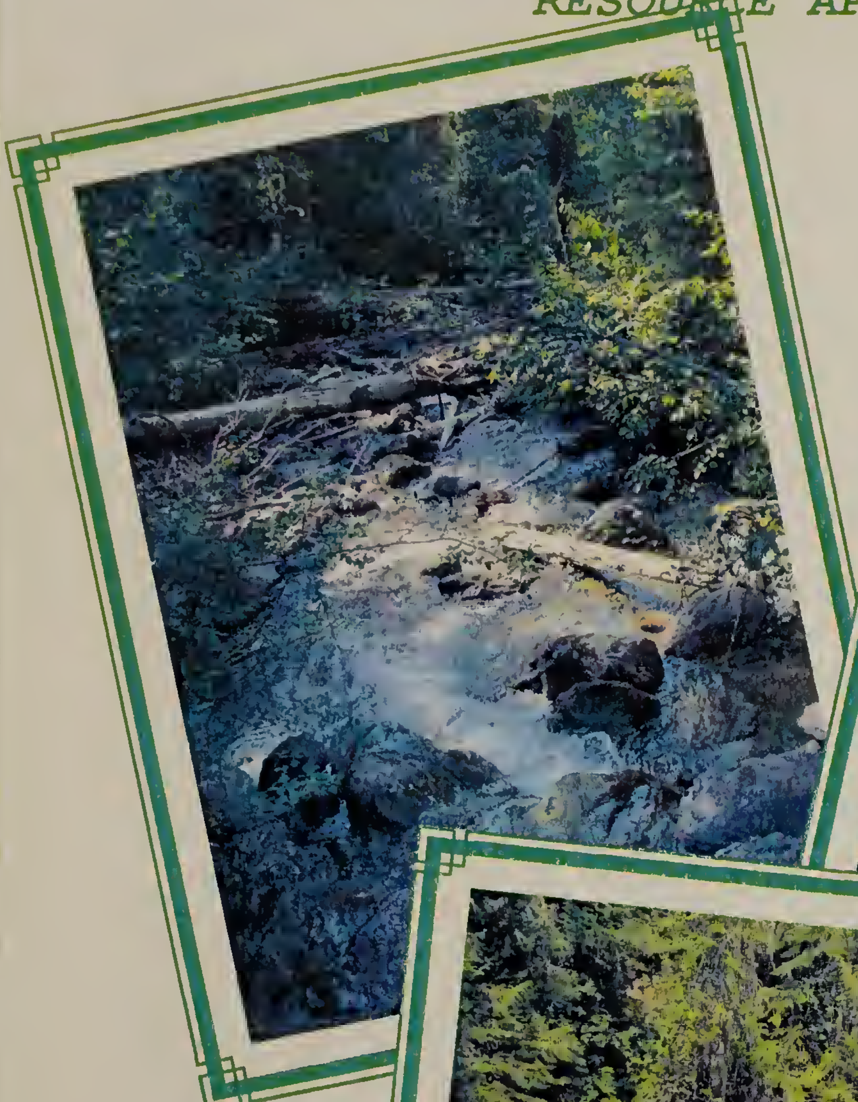
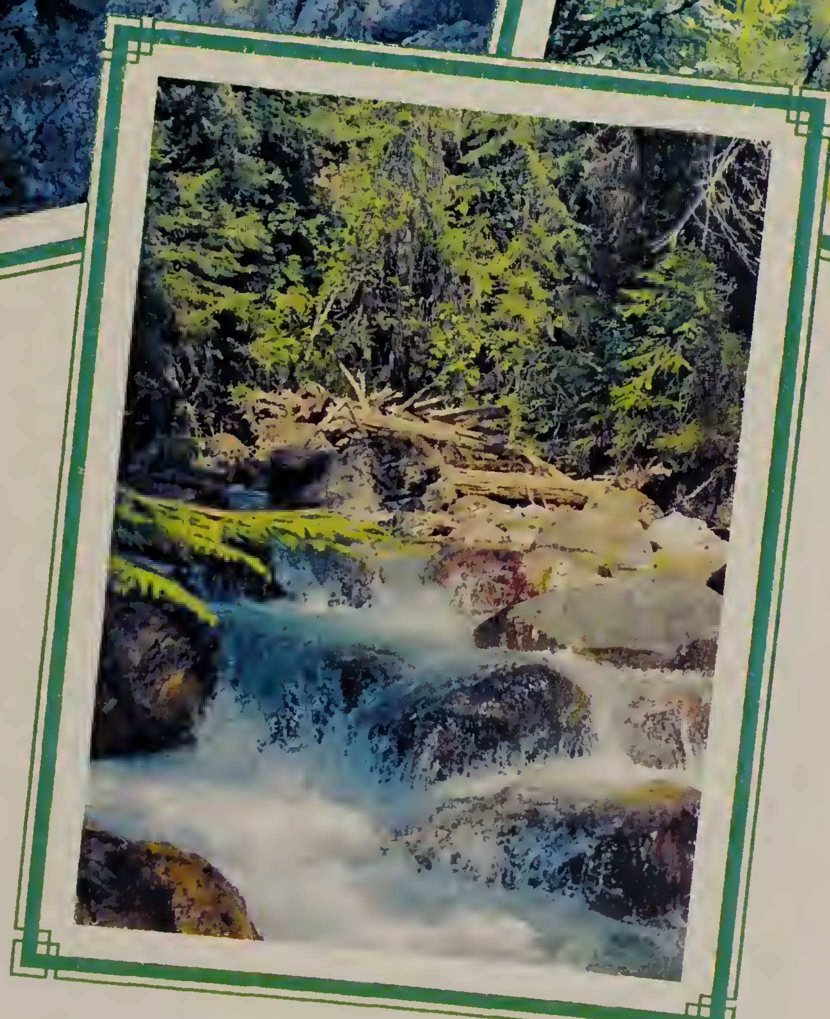
# Three Creeks Timber Sale Project

## DRAFT ENVIRONMENTAL IMPACT STATEMENT
## RESOURCE APPENDICES







Department of Natural Resources and Conservation
Swan River State Forest
AUGUST 2006

# Three Creeks Timber Sale Project Area
## Vicinity Map

Appendix A
Related
Reviews

# APPENDIX A
# LIST OF RELATED ENVIRONMENTAL REVIEWS

## INTRODUCTION

In order to address direct, indirect, and cumulative effects on a landscape level, the analysis must incorporate past, present, and future actions within the analysis area. The following activities are located within the Three Creeks environmental analysis area for vegetation on Swan River State Forest. The environmental analysis areas for watershed, wildlife, soils, fisheries, etc., are smaller in size and encompass an area specific to those disciplines.

## DNRC TIMBER SALE AND ROAD PROJECTS

State timber sales where environmental analyses have been completed and sale activities have begun or have been completed:

- Goat Squeezer Timber Sale Project EIS
- Napa Lookout Permit
- Cilly Bug Salvage Permit
- Rock Squeezer Salvage Permit
- Red Ridge Salvage Permit

State timber sale proposals with an environmental review in progress:

- The Fridge Salvage Permit (2006)
- Various thinning projects

The proposed White Porcupine Timber Sale Project is identified on the DNRC 3-Year Listing as the next potential project for Swan River State Forest. As yet, however, an initial proposal or proposed action has not been done. The potential project has not been scoped and, therefore, DNRC has not initiated a preimpact study on this proposal.

## SWAN VALLEY GRIZZLY BEAR CONSERVATION AGREEMENT (SVGBCA)

Beginning in December 1994, DNRC has participated in the development and utilization of the SVGBCA with the United States Fish and Wildlife Service (USFWS), Flathead National Forest (FNF), and Plum Creek Timber Company. The SVGBCA seeks to cooperatively manage grizzly bear habitat in Swan Valley, where intermingled ownership patterns and differing land-management objectives complicate habitat management for a species as wide-ranging as the grizzly bear. USFWS evaluated the SVGBCA in an environmental assessment and found that implementing the Agreement's management guidelines would not negatively impact grizzly bears (*USFWS 1995*).

The Three Creeks Timber Sale Project area is within the conservation area delineated in the SVGBCA and complies with its guidance.

## OTHER ACTIVITIES

None

Appendix B

Stipulations and Specifications

# APPENDIX B
# STIPULATIONS AND SPECIFICATION

## INTRODUCTION

The stipulations and specifications for the action alternatives were identified or designed to prevent or reduce the potential effects to the resources considered in this analysis. In part, stipulations and specifications are a direct result of issue identification, project mitigations, and resource concerns.

Stipulations and specifications that apply to harvesting or road-building operations will be contained within the Timber Sale Contract. As such, they are binding and enforceable. Project administrators will enforce stipulations and specifications relating to activities that may occur during or after the contract period, such as site preparation or hazard reduction.

The following stipulations and specifications will be incorporated to mitigate effects on the resources involved with the action alternatives considered in this proposal. Each section is organized by resource.

## VEGETATION

### ➢ Sensitive Plants

Appropriate protection measures will prevent the disturbance of sensitive plant populations. Riparian areas near harvest units will be marked to protect SMZs and isolated wetlands. No harvesting is planned in wetlands or near springs on localized features. If sensitive plant populations are found, the appropriate habitat area will be excluded from the harvest units.

### ➢ Noxious Weed Management

To further limit the possibility of spreading noxious weeds, the following weed-management mitigation measures will be implemented:

- All tracked and wheeled equipment will be cleaned of noxious weeds prior to beginning project operations. The contract administrator will inspect equipment periodically during project implementation.
- Surface blading on roads affected by the proposal may be required to remove weeds before the seed-set stage.
- Disturbed roadside sites will be promptly reseeded. Roads used and closed as part of this proposal will be reshaped and seeded.
- Herbicide application, as designated by the forest officer, may be used to control weeds along roads that access the timber sale area.

### ➢ Herbicides

- To reduce risks to aquatic and terrestrial resources, the following will be required:
- All herbicides will be applied by licensed applicators in accordance with laws, rules, and regulations of the State of Montana and Lake County Weed District.

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- All applications will adhere to BMPs and the herbicides' specific label guidelines.
- Herbicide applications will not be general, but site specific to areas along roads where noxious weeds grow. No-spray areas will be designated on the ground before applications begin.
- Herbicides will not be applied to areas where relief may contribute runoff directly into surface water.
- Herbicides will be applied on calm, rainless days to limit drift and the possibility of the herbicide moving off the road prisms.

**WATERSHED AND FISHERIES**

- Planned erosion-control measures and BMPs include:

- installing grade breaks on roads,
- installing water-diverting mechanisms on roads,
- installing slash-filter windrows, and
- grass seeding.

- All road-stream crossings will be monitored for sedimentation and the deterioration of the road prism.
- Equipment traffic will be allowed at road-stream crossings only where road prisms have an adequate load-bearing capacity.
- Culvert sizing for all road projects will be as recommended by the DNRC hydrologist for a 50-year-flood period.
- Stream crossings, where culvert or bridge removals and installations are planned, will have the following requirements, as needed, to meet the intent of water-quality permits and BMPs and protect water quality:
  - diversion channels will be constructed and lined with plastic to divert stream flow prior to any in-channel operations,
  - slash-filter windrows will be constructed on the base of the fill slopes,
  - silt fences will be installed along the streambanks prior to and following excavation at crossing sites,
  - filter-fabric fences will be in place downstream prior to and during culvert installation, and
  - bridge work within stream areas will be limited to the period of July 15 through August 31.
- Brush will be removed from existing road prisms to allow effective maintenance. Improved road maintenance will reduce sediment delivery.
- The contractor will be responsible for the immediate cleanup of any spills (fuel, oil, dirt, etc.) that may affect water quality.
- Equipment that is leaking fluids will not be permitted to operate in stream-crossing construction sites.
- Included in the project proposal are the following pertinent recommendations of the *Flathead Basin Forest Practices, Water Quality and Fisheries Cooperative Program Final Report, June 1991.* (The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154-162 of the *Final Report.*)

  1. BMPs are incorporated into the project design and operations.
  2. Riparian indicators would be considered in the harvest unit layout.
  3. Management standards of the SMZ Law (*75-5-301 MCA*) are used in conjunction with the recommendations of the study.

4. The BMP audit process will continue. This sale would likely be reviewed in an internal audit and may be randomly chosen as a Statewide audit site.

7. SMZs will be evaluated as a part of the audit process.

12. Watershed-level planning and analysis are completed. Logging plans of other agencies and private companies are used.

14. DNRC is cooperating with DFWP on the further study of fish habitat and populations for South Lost, Cilly, and Soup creeks.

15. DNRC would use the best available methods for logging and road building for this project.

16A. Existing roads are fully utilized for this proposal.

16B. DNRC utilizes BMPs, transportation planning, and logging system design to minimize new road construction.

17. DNRC requested inventory information from DFWP (versus contracts with DFWP to obtain species composition, spawning inventory, and spawning habitat quality). DNRC's mitigation plan for roads fits all recommendations for "impaired streams". Using "worst-case scenario" criteria provides for conservative operations in this proposal.

18. Provisions that address BMPs are in the Timber Sale Contract, which are rigidly enforced.

20. Long-term monitoring is planned for South Lost, Cilly, and Soup creeks, as well as other streams on Swan River State Forest.

29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC would continue to monitor fisheries in the future as funding allows.

- SMZs and RMZs will be defined along those streams that are within or adjacent to harvest units, and all applicable BMPs and the Rules for fisheries RMZ to fish-bearing streams will be followed.
- For the major streams (South Fork Lost, Cilly, Unnamed, and Soup creeks), a 300-foot buffer (150 feet on each side of the stream) will be maintained in areas where harvesting takes place on both sides of the stream or a closed canopy of, at least, pole-sized timber is on either side of the stream. Within the 300-foot buffer, a 25-foot no-harvest zone will be located immediately adjacent to the stream. Throughout the rest of the buffer, an average canopy closure of 40 percent will be maintained. The creation of some small openings up to 0.25 acre in size will be allowed as long as an average canopy closure of 40 percent could be achieved throughout.
- The SMZ law and Rules will be applied to all non-fish-bearing streams in the project area.
- *McNeil* core and substrate scores will be monitored in bull trout spawning reaches in South Fork Lost and Soup creeks.
- Fish-habitat monitoring, such as repeat R1/R4 surveying, will be done in South Fork Lost and Soup creeks.
- Riparian stand characteristics (quadratic mean diameter, trees per acre, basal area) will be monitored in proposed selective riparian harvest areas adjacent to South Fork Lost and Soup creeks.

- Angular canopy density (shade) will be monitored in South Fork Lost and Soup creeks adjacent to proposed selective riparian harvest areas.
- The frequency and volume of large woody debris will be monitored in South Fork Lost and Soup creeks.
- Stream temperature will be monitored in South Fork Lost, Cilly, and Soup creeks.

**WILDLIFE**

➢ *Grizzly Bears*

- All action alternatives will comply with the SVGBCA.
- Roads and landings will be seeded to revegetate with species less palatable to grizzly bears to minimize the potential for bear-human conflicts.
- Contractors will haul garbage or store it in a safe place so bears will not be attracted to the area.
- No logging camps will be allowed within the sale area.
- The Forest Officer will immediately suspend activities directly related to the project to prevent imminent confrontation or conflict between humans and grizzly bears, or other threatened or endangered species.
- Contractors are prohibited from carrying firearms onto closed roads while working under contract.
- Where regeneration harvests are proposed along open roads, vegetation screening will be retained within a 100-foot buffer.
- Where regeneration harvests are proposed, no point in the harvest unit will exceed 600 feet to cover.

➢ Wolves

A provision will be included in the Timber Sale Contract to protect wolf dens or rendezvous sites within the gross sale area discovered during implementation of the project.

➢ Big Game

The purchaser will be authorized to enter the project area with motorized vehicles only for activities related to the performance of the Timber Sale Contract. Road use is restricted to nonmotorized transportation behind road closures for any other purpose. Motorized vehicle entry for purposes other than contract performance, such as hunting or transporting game animals, will be considered in trespass and prosecuted to the fullest extent of law (*ARM 45-6-203*).

➢ Wildlife Trees and Snag Retention and Recruitment

- Wildlife trees of high quality, such as large broken-topped western larch, will be designated for retention and given special consideration during yarding operations to prevent loss.
- Snag retention and recruitment: All cull snags that are safe to operate near and a minimum of 2 snags greater than 21 inches dbh are to be retained. If not enough large snags are present, the balance will be made up from the next largest size class available.
- If snags that are expected to be retained need to be felled for operational or safety reasons, they will be left on site.

## SOILS

### ➢ *Compaction*

- Logging equipment will not operate off forest roads unless:
  - soil moisture is less than 20 percent,
  - soil is frozen to a depth of 4 inches or a depth that will support machine operations (whichever is greater), or
  - soil is snow covered to a depth of 18 inches or a depth that will prevent compaction, rutting, or displacement (whichever is greater).
- Existing skid trails and landings will be used when their design is consistent with prescribed treatments and current BMP guidelines are met.
- The logging foreman and sale administrator will agree to a skidding plan prior to operating equipment.
- To reduce the number of skid trails and the potential for erosion, designated skid trails will be required where moist soils or short steep pitches (less than 300 feet) will not be accessed by other logging systems.
- The density of skid trails in a harvest area will not exceed 20 percent of the total area in the cutting unit.

### ➢ Soil Displacement

- Conventional ground-based skidding equipment will not be operated on slopes steeper than 40 percent. Soft-tracked yarders are suitable on slopes up to 55 percent. Cable yarding will be used on sustained steeper slopes.
- Slash piling and scarification will be completed with a dozer where slopes are gentle enough to permit (less than 35 percent). Slash treatment and site preparation will be done with an excavator in areas where soils are wet or slopes are steeper (up to 55 percent). Broadcast burning may also be utilized.

### ➢ Erosion

- Ground-skidding machinery will be equipped with a winchline to limit equipment operation on steeper slopes.
- Roads used by the purchaser will be reshaped and the ditches redefined to reduce surface erosion prior to and following use.
- Drain dips, open-topped culverts, and gravel will be installed on roads as needed to improve road drainage and reduce erosion and maintenance needs.
- Some road sections will be repaired to upgrade the roads to design standards that will reduce the potential for erosion and maintenance needs.
- Certified weed-free grass seed and fertilizer will be applied promptly to newly constructed road surfaces, cutslopes, and fillslopes. These applications will also be done on existing disturbed cutslopes, fillslopes, and landings immediately adjacent to open roads. These applications, which will stabilize soils and reduce or prevent the establishment of noxious weeds, would include:
  - seeding all road cuts and fills concurrent with construction,
  - applying "quick cover" seed mix within 1 day of work completion at culvert installation sites, and
  - seeding all road surfaces and reseeding culvert installation sites when the final blading is completed for each specified road segment.

- Based on ground and weather conditions and as directed by the forest officer, water bars, logging-slash barriers, and, in some cases, temporary culverts will be installed on skid trails where erosion is anticipated. These erosion-control features would be periodically inspected and maintained throughout the Contract period or extensions thereof.

**AIR QUALITY**

- To prevent individual or cumulative effects and provide for burning during acceptable ventilation and dispersion conditions during burning operations, burning will be done in compliance with the Montana Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2.
- Excavator, landing, and roadwork debris will be piled clean to allow easy ignition during fall and spring when ventilation is good and surrounding fuels are wet. The Forest Officer may require that piles be covered to reduce dispersed (unentrained) smoke and allow the piles to ignite more easily, burn hotter, and extinguish more quickly.
- The number of piles to burn will be reduced by leaving large woody debris in the harvest units.
- Depending on the season of harvest and level of public traffic, dust abatement may be applied on some segments of the roads that will be used during hauling.

**AESTHETICS**

- Damaged submerchantable residual vegetation will be slashed.
- Landings will be limited in size and number and located away from main roads when possible.
- Disturbed sites directly adjacent to roads will be grass seeded.
- When possible, healthy trees not big enough to be harvested will be retained.

**CULTURAL RESOURCES AND ARCHAEOLOGY**

- A review of the project area was conducted by a DNRC archaeologist and local Native American tribal organizations.
- A contract clause provides for suspending operations if cultural resources are discovered and only resuming when directed by the Forest Officer.

**ROADS**

- Information about road reconstruction activities and road use associated with road construction activities will be relayed to the general public.
- Signs will be placed on restricted roads to prohibit public access while harvesting operations are in progress; these roads will be physically restricted during inactive periods (nights, weekends, holidays, shutdowns).
- BMPs will be incorporated into all planned road construction.

**Appendix C**

**Vegetation Analysis**

# APPENDIX C
# VEGETATION ANALYSIS

## INTRODUCTION

This section describes current vegetative conditions on Swan River State Forest and addresses the potential effects of the alternatives as they relate to the following issues:

- movement toward or away from desired future conditions;
- management goals and activities that address insect and disease activities;
- current and future levels of forest fragmentation;
- impacts of harvesting on the amount and distribution of old growth, old-growth attributes, and the quality of old growth on Swan River State Forest;
- timber harvesting and associated activities may affect forest covertypes and age classes;
- timber harvesting and associated activities may reduce canopy cover;
- without timber harvesting, fire hazard may increase;
- timber harvesting and associated activities may decrease sensitive plant populations; and
- timber-harvesting and road-building activities may increase noxious weeds in the project area.

## ANALYSIS METHODS

The *Rules (http:// arm.sos.state.mt.us/ Title 36)* direct DNRC to take a landscape-level or coarse-filter approach to biodiversity. To promote biodiversity, an appropriate mix of stand structures and compositions on State land should be favored (*Montana DNRC 1996*). The coarse-filter approach utilizes landscape-analysis techniques to determine an appropriate mix of stand structures and compositions for Swan River State Forest based on ecological characteristics, such as landtypes, climatic sections, habitat types, disturbance regimes, and other unique characteristics.

This vegetation analysis compares historic forest conditions, desired future conditions, and current stand conditions in terms of forest composition. Covertype representations and age-class distributions are specific characteristics shown in the landscape-level analysis to quantify project effects to forest

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vegetation and track movement toward or away from desired future conditions.

Historic age-class and covertype conditions were quantified by *Losensky (1997)*. He used forest inventory data from the 1930s to estimate the proportion of historic age classes by forest covertype for Montana. This provided an estimate of age-class distribution and stand composition prior to Euro/American settlement and the effects of fire suppression, selective logging, cattle and sheep grazing, and the full impact of white pine blister rust. Current conditions and desired future conditions are defined using DNRC's site-specific SLI.

Forest fragmentation was analyzed by using aerial photographs of the project area and querying the SLI. Aerial photographs provided a visual of past harvesting and current stand appearances (stocking density, stand boundaries, etc.). Queries in the SLI provided information on contiguous areas of stands in the same age class, stocking levels, and stand densities. Alternative effects on the patch size of old-growth stands were also analyzed. Field visits helped to verify this information to establish increases/ decreases in a given patch size.

Insect and disease activities are recorded and mapped annually from aerial flight surveys. New occurrences and progression of existing pockets, along with approximate acreages and locations, are collected. Field surveys identify areas with insect and disease activities for timber harvesting opportunities. Several successive years of flight-survey maps are available at the Swan River State Forest office.

The old-growth analysis relies on both DNRC's SLI and plot-level data collected for the project. The SLI was queried to select stands meeting the age, dbh, and large-tree criteria for old growth based on habitat-type groups (see *GLOSSARY* for DNRC's old-growth definition). Field surveys were employed to collect plot-level data in order to verify the old-growth status of selected stands and determine if additional stands meet the old-growth definition within the project area. Attribute levels within old-growth stands are described and analyzed for preharvest and postharvest conditions using the SLI and the additional plot-level data collected.

The analysis of stand development would be a qualitative discussion of the conditions of timber stands, including how various natural and man-caused disturbances and site factors have affected, and may continue to affect, timber-stand development. Project level and cumulative effects to forest vegetation are described and analyzed in terms of covertype representation, age-class distributions, old-growth amounts and attribute levels, stand structure, patch dynamics, forest fragmentation, and the role of insects and diseases.

## ANALYSIS AREA

The analysis area was examined at 3 nested scales:

- the climatically-/ physiographically-defined "Upper Flathead Section" (M333C) of the larger, vegetation-defined "Northern Rocky Mountain Forest-Steppe-Coniferous Forest-Alpine Meadow Province" (Province M333) (*Bailey et al. 1994*);
- Swan River State Forest;
- and the Three Creeks Timber Sale Project area.

Climatic sections were described as broad areas of similar geomorphic processes, geologic origins, drainage networks, and landforms that influence precipitation patterns and temperature regimes (*Losensky 1997:19*). General

location-based names for the various climatic sections were assigned to help understanding and communication. The Three Creeks Timber Sale Project area in Swan River State Forest affects the timber base and sustainable yield derived through the forest-management program. Swan River State Forest is within Climatic Section M333C. Considering that each nested scale is important because activities within one can influence all, and effects at one scale may be unapparent when presented at another scale.

- Section M333C: Historic conditions refer to those described by *Losensky (1997)*. In this analysis, the historic conditions for Section M333C relate to Swan River State Forest in terms of age-class distributions by forest covertypes.
- Swan River State Forest: Current and desired future conditions were analyzed at the scale of the entire Swan River State Forest, based on the Swan River State Forest SLI.
- Three Creeks Timber Sale Project Area: Within the project area, the effects to stands proposed for harvesting would be analyzed under each alternative.

Effects analyses are presented for both the entire Swan River State Forest and the project-level analysis area throughout the DEIS. Much of the analysis uses data from the SLI. The SLI quantifies forest-stand characteristics for all stands in Swan River State Forest and is incorporated into DNRC's Geographic Information System (GIS).

The SLI is updated annually to account for harvesting activities and periodically through reinventory. This process provides DNRC foresters with current data for use in analyses of proposed management activities. Since ongoing and future timber sales have not undergone postharvest inventory, probable effects of these sales are taken into consideration in order to address cumulative impacts in each analysis area. The SLI databases used for this analysis are dated August 8, 2001 (*sli poly 08082001 swn*), and May 13, 2005 (*swn sliwsnc20050513*). This data is available at the Swan River State Forest office.

One timber sale, Cilly Bug Salvage Timber Sale, is in progress within the Three Creeks Timber Sale Project analysis area. The estimated effects of this project on the proportions of forest covertypes and age classes, along with effects of old-growth stands, would be considered along with the Goat Squeezer (I, II, III), Small Squeezer, Small Squeezer II, and South Woodward timber sales in a cumulative-effects analysis for Swan River State Forest.

**PAST MANAGEMENT**

The project area has not had a large timber sale since the 1980s. Timber harvesting began in and adjacent to the project area during the 1960s. The first known harvesting, both inside and adjacent to the project area, took place in the early 1900s. Limited salvaging has taken place within the project area, but several permits have been completed in the adjacent area. The majority of the acres (54 percent) in the project area have never been harvested.

Most previously harvested stands have regenerated successfully, either naturally or by planting, and are dominated by western larch, Douglas-fir, and, in some areas, ponderosa pine. Many units have recently been precommercially thinned. Other past harvesting includes salvage, sanitation, and individual-selection treatments. Salvage harvesting, the most prominent type of harvesting, began in the early 1980s and continued through the late 1990s; salvage

operations have not occurred in the project area for the last several years. Individual-tree-selection harvesting was conducted in the early 1970s.

**STAND DEVELOPMENT**

Natural processes of stand development and disturbance are influenced by environmental conditions and site characteristics, such as soils, stand covertype, forest health, elevation, and stand structure. The stand structures and species compositions can be greatly modified by natural disturbances, such as wildfire and blowdown. Without natural or human-caused disturbances, stands continue to move along the successional path, which leads to species conversion. In some instances, a previously open western larch/Douglas-fir stand begins developing an increasingly dense understory of grand fir and other shade-tolerant tree species. This process can eventually move the stand towards a mixed-conifer covertype. Many of the stands proposed for harvesting have this successional pattern occurring. Proposed treatments would reverse this process to earlier stages of succession dominated by seral species.

**HABITAT TYPES**

Site factors, such as soil type, aspect, elevation, growing season, and moisture availability, are combined to develop the classifications of habitat types, which are then used to describe successional development and timber productivity, among other things (*Pfister et al. 1977*). In the project area, 62 percent is categorized as belonging to the "warm and moist" habitat type. As these stands progress through successional stages, the mixed-conifer covertype would become more dominant. The lower elevation, moist-subalpine habitat type (*Fischer and Bradley, 1987*) occurs on 25 percent of the area. Also represented in the project area are 5 other habitat types, but in much lesser amounts. Information on habitat types for the remaining stands is available in the project file.

The stands proposed for harvesting are included in the warm and moist along with the lower elevation, moist subalpine fir habitat type groups. These groups typically have relatively high timber production, regenerate best with more intensive management treatments, and provide great opportunities for seral species. *TABLE C-1 - ACRES TREATED PER HARVEST PRESCRIPTION BY HABITAT-TYPE GROUP* shows the amount of acres being treated within these habitat type groups by harvest prescription.

**FOREST HEALTH**

Stand vigor, a qualitative assessment of stand health in relation to growth potential, is affected by a variety of factors such as stand age, density, insects, diseases, and weather. Insects and diseases are currently very active within the project area, decreasing vigor, reducing growth, causing mortality, removing stands from the old-growth classification, and resulting in lost economic value. Elevated populations of Douglas-fir beetle, fir engraver, and mistletoe, as well as minor infestations/ infections from mountain pine beetle, white pine blister rust, and various heart rots exist throughout the project area. Indian paint fungus is common in grand fir. The majority of the tree species show effects from insect infestations and/or disease infections, which cause value to be lost. Also, tree crowns appear sparse, yellowing, and/or fading in many stands, reflecting poor health and slow growth.

The SLI identifies stand vigor for each stand on Swan River State Forest in 1 of 4 categories. The 4 categories for vigor classification

*TABLE C-1 - ACRES TREATED PER HARVEST PRESCRIPTION BY HABITAT-TYPE GROUP*

| ACTION ALTERNATIVE | HARVEST PRESCRIPTION | HABITAT TYPE GROUPS | | |
|---|---|---|---|---|
| | | WARM AND MOIST | MOIST, LOW ELEVATION SUBALPINE | *TOTALS* |
| B | Seedtree | 134 | | 134 |
| | Seedtree reserve | 543 | | 543 |
| | Shelterwood | 593 | 61 | 654 |
| | Commercial thin | 486 | 67 | 553 |
| C | Seedtree | 98 | | 98 |
| | Seedtree reserve | 480 | | 480 |
| | Shelterwood | 675 | | 675 |
| | Commercial thin | 531 | 67 | 598 |
| D | Seedtree | 113 | | 113 |
| | Seedtree reserve | 540 | 133 | 673 |
| | Shelterwood | 314 | 309 | 623 |
| | Commercial thin | 439 | 121 | 560 |
| E | Seedtree | 135 | | 135 |
| | Seedtree reserve | 441 | 133 | 574 |
| | Shelterwood | 461 | 143 | 604 |
| | Commercial thin | 580 | 103 | 683 |

are full, good, fair, and poor. The majority of the stands in the project area fall in the good to average category, which is also reflective of the stands proposed for harvesting (*TABLE C-2 - STAND-VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE*).

***TABLE C-2 - STAND-VIGOR CLASSIFICATION (PERCENT) BY ACTION ALTERNATIVE***

| VIGOR | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|
| | B | C | D | E |
| Good | 51 | 53 | 59 | 58 |
| Fair | 38 | 39 | 30 | 41 |
| Poor | 11 | 8 | 11 | 1 |

**ELEVATION AND ASPECT**

Elevation and aspect interact to influence the tree and shrub species potentially present in a stand, as well to influence successional pathways and percent of ground cover. The project area ranges in elevation from 3,400 to 6,600 feet. A large portion of the project area has a south-to-west-to-northwest aspect, resulting in sites that are relatively warmer and drier than those on north- or east-facing aspects. Warmer, drier stands typically develop overstories of western larch and/or Douglas-fir, or, occasionally, ponderosa pine on the drier sites. Stands with north-facing slopes, either entirely or in part, often have higher moisture availability and are located where species such as western red cedar and true firs are often found.

The majority (61 percent) of the old-growth stands proposed for harvesting are on south to west aspects in the mid-elevation zone, between 3,500 and 4,500 feet. Treatments for these particular stands vary depending on the aspect

and elevation and the influence these would have on regeneration. The south to west aspect sites receive much direct sunlight and tend to have drier soils. Due to these sites being drier and warmer, shelterwood and commercial-thin treatments are proposed for these aspects. These treatments would also provide a greater opportunity for regeneration survival.

**STAND STRUCTURE**

Stand structure indicates a characteristic of stand development and how the stand would continue to develop. The disturbance regime or most recent disturbance event can also be reflected.

Single-storied stands are most often associated with stand-replacement events, such as severe fires or clearcut harvesting, and are more common in younger-aged stands where understory reinitiation has not begun. Over time, these single-storied stands generally develop into multistoried stands or other more complex structures through the process of forest succession.

Two-storied stands are often associated with areas of less severe fires and usually have more fire-resistant trees, such as western larch or Douglas-fir, left in the overstory. Also, two-storied stands frequently develop where an understory of shade-tolerant species grows under an even-aged overstory, such as subalpine fir growing under a canopy of lodgepole pine. Regeneration harvests that retain approximately 10 percent crown cover in the overstory and have a seedling/sapling understory are also classified as two-storied stands.

The multistoried condition arises when a stand has progressed through time and succession to the point that shade-tolerant species are replacing a shade-intolerant overstory. Often a long interval of time occurs between major disturbances. Many of these stands went through a single-story condition when younger.

Seedtree and seedtree-with-reserves harvest treatments would shift stands from their current structure class to a single-storied class. Shelterwood treatments would initially move stands from the current structure to a single story, which would again shift to a two-storied stand upon establishment of seedlings. Commercial-thin harvest treatments would vary depending on the current structure and the proposed timber removal. Much of the understory disturbed through logging operations and harvesting would primarily occur in the dominant, co-dominant, and intermediate canopy layers. Stand structure may be reduced by one or more classes, two-storied or three-storied (multistoried).

*TABLE C-3 - CURRENT AND POSTHARVEST STAND STRUCTURE OF UNITS PROPOSED FOR HARVEST IN THE THREE CREEKS PROJECT AREA* compares the current proportion of stands and the postharvest results by alternative in single-storied, two-storied, and multi-storied stands within the project area.

***TABLE C-3 - CURRENT AND POSTHARVEST STAND STRUCTURE OF UNITS PROPOSED FOR HARVEST IN THE THREE CREEKS PROJECT AREA***

| STAND STRUCTURE | CURRENT AMOUNTS | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|---|
| | | B | C | D | E |
| | | POSTHARVEST | | | |
| Single-storied (percent) | 25 | 37 | 37 | 37 | 37 |
| Two-storied (percent) | 10 | 13 | 13 | 12 | 12 |
| Multistoried (percent) | 65 | 49 | 50 | 51 | 51 |
| *Total acres* | *10,383* | *10,383* | *10,383* | *10,383* | *10,383* |

## COVERTYPE AND AGE CLASSES

### *EXISTING CONDITION*

Covertypes describe the species composition of forest stands. Covertype representation often varies according to the frequency of disturbance. Some seral-species-dominated types, such as ponderosa pine, reflect a frequent low-intensity disturbance that helps perpetuate the shade-intolerant pine. Other types, such as the mixed-conifer type, reflect an absence of disturbance, indicating stands further along the successional pathway dominated by shade-tolerant species.

The protocol used to assign covertypes on DNRC forested lands, including Swan Unit, is explained in detail in the *Rules (ARM 36.11.405) (http://arm.sos.state.mt.us/)*. The methods used to analyze current and appropriate stand conditions are described below.

Two data filters were developed to assign covertypes in a manner similar to that used in the 1930s inventory and applied to Swan River State Forest's SLI data (*swn sliwsnc20050513; Arc View* shape file). The first, representing current conditions, followed the 1930s criteria as closely as possible. The second, representing desired future conditions, assigned covertypes using criteria to address situations where the current type may not be representative of desired conditions, such as stands where succession from one covertype to another was occurring. Without fire suppression, introduced pathogens, and timber harvesting, the filter for desired future conditions indicated that those areas would likely have been assigned to a different covertype than the current covertype filter suggests. The filter for desired future conditions provides an assessment for the proportion of various covertypes that would likely have existed under average historic conditions.

*FIGURE C-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST*, *FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST*, and *FIGURE C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST* illustrate the proportion of forest occupied by various covertypes at differing scales and time periods. *FIGURE C-1* shows the historical proportional representation of covertypes for Swan River State Forest.

***FIGURE C-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST***

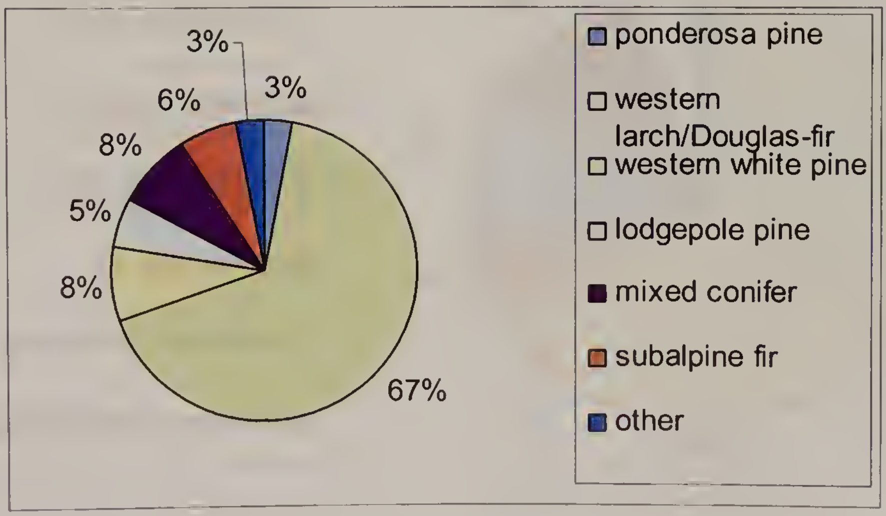
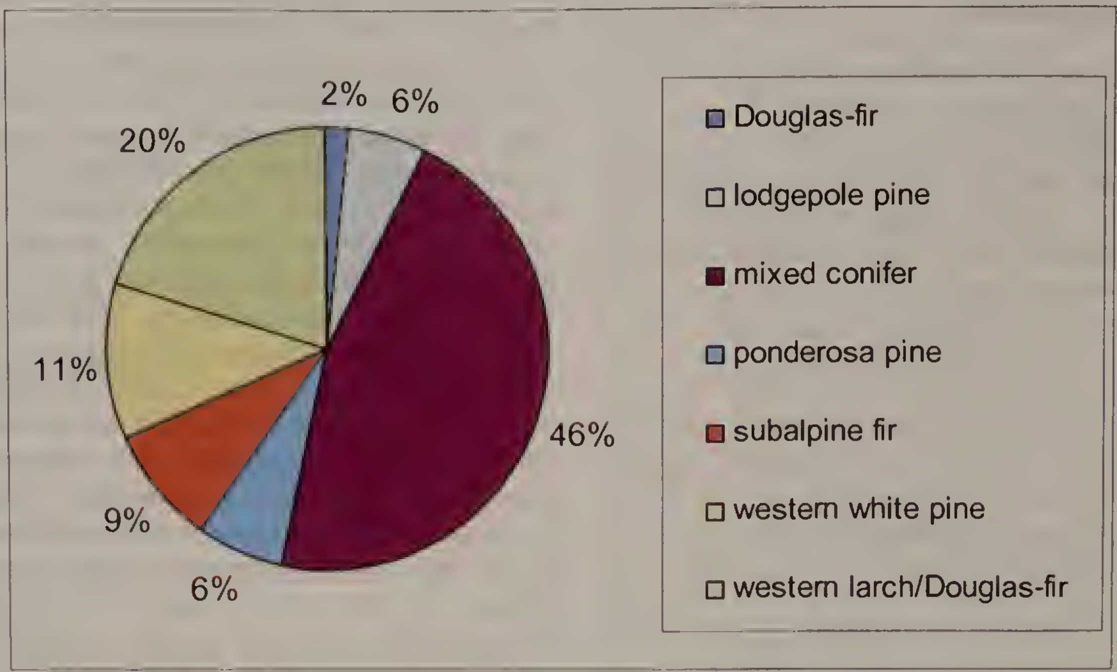


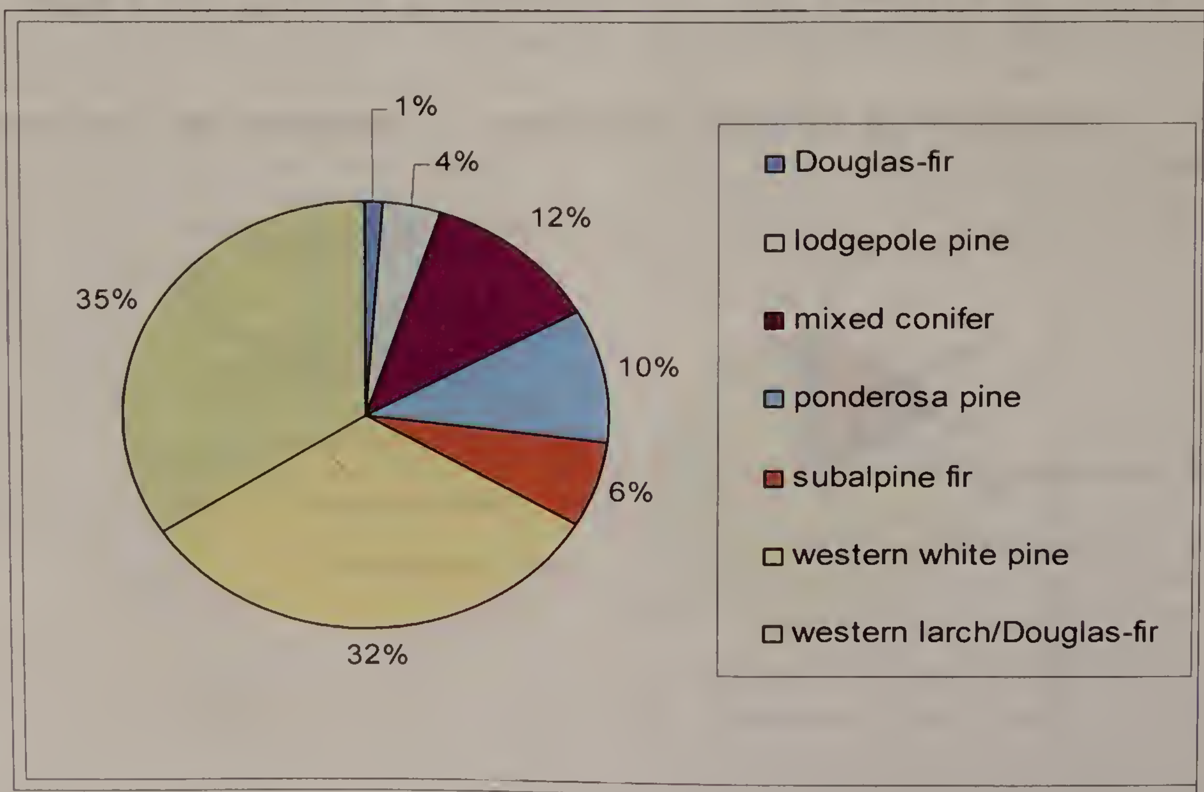
*FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST*




Results indicate (*FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST*, and *FIGURE C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST*) that mixed-conifer stands are currently overrepresented compared to historic data and desired future conditions. Many of the species that compose mixed-conifer stands are shade tolerant and increase in density as the intervals between disturbances, such as wildfires, increase.

The western larch/Douglas-fir and western white pine covertypes are currently underrepresented on Swan River State Forest, in reference to desired future condition, but for different reasons. Western larch and Douglas-fir are preferred timber

*FIGURE C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST*



species that often were removed in partial or selective harvests that failed to provide suitable conditions for regenerating the species. Western larch/Douglas-fir stands have historically been perpetuated through fairly intensive disturbances, such as wildfires, and because, when mature, they are more resistant to fire mortality than other species, some individuals would survive a natural disturbance and provide a seed source for subsequent regeneration. The lack of natural disturbances has prevented regeneration of western larch across much of Swan River State Forest, particularly in the dense old stands common throughout the project area, and resulted in a shift in dominance from shade-intolerant species, like western larch/Douglas-fir, toward more shade-tolerant species.

Data for Swan River State Forest indicates that the extent of the western white pine covertype is considerably lower than what occurred historically. White pine blister rust has drastically affected western white pine, reducing its representation across its range to less than 10 percent of historical numbers (*Fins et al. 2001*). The number of healthy western white pine that occupy the canopy as overstory dominants has been on the decline across its range for several decades despite multiorganization cooperative efforts to restore it on the landscape. So, while cooperative efforts have produced rust-resistant seed suitable for deployment throughout its range, planting has been unable to keep pace with losses due to the rust.

### *AGE-CLASS DISTRIBUTION*

Age-class distribution delineates another characteristic important for determining trends on a landscape level. Age-class distributions are tied to covertype representation and disturbance regimes, both of which vary over the landscape in relation to prevailing climatic conditions of temperature and moisture.

Historical stand age-class distributions for Montana were developed by *Losensky (1997)*. Although the data was collected at a specific point in time, this data represents the best baseline available for determining how current forest age-class distribution deviates from historical conditions.

Comparison of the current age-class distribution by covertype across the entire Swan River State Forest to historical data from Section M333C demonstrates reduced acreage in the seedling-sapling age class and an overabundance in the 150+-year-old age class (*TABLE C-4 - HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION 333C (UPPER FLATHEAD VALLEY); NONFOREST LAND IS NOT INCLUDED* and *TABLE C-5 - 1930S INVENTORY DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE FOR SWAN RIVER STATE FOREST AND TOTAL ACRES BY COVERTYPE [THE AVERAGE REPRESENTS THE AVERAGE AGE-CLASS STRUCTURE ACROSS ALL COVERTYPES]*) in most types. The relatively old age of stands in Swan River State Forest predisposes them to attacks by insects and diseases, as well as an increased risk of stand-replacement fires.

Comparing the climatic section averages with Swan River State Forest shows that the forest was dominated by old stands to a much greater extent than was the climatic section, 74 percent old stands versus 29 percent. That trend was also demonstrated with most of the various covertypes.

*TABLE C-4 - HISTORIC AGE-CLASS STRUCTURE FOR EACH COVERTYPE IN CLIMATIC SECTION 333C (UPPER FLATHEAD VALLEY); NONFOREST LAND IS NOT INCLUDED*

| COVERTYPE[1] | NONSTOCKED | 1 TO 40 YEARS | 41 TO 100 YEARS | 101 YEARS TO OLD STANDS | OLD STANDS[2] |
|---|---|---|---|---|---|
| | PERCENT | | | | |
| Ponderosa Pine | 2 | 11 | 6 | 7 | 74 |
| Douglas-fir | 2 | 24 | 39 | 29 | 6 |
| Western larch/ Douglas-fir | 10 | 13 | 10 | 20 | 47 |
| Western white pine | 0 | 1 | 28 | 54 | 17 |
| Lodgepole pine | 21 | 38 | 29 | 7 | 5 |
| Mixed conifer | 2 | 4 | 9 | 42 | 43 |
| Average | 14 | 22 | 13 | 22 | 29 |

*[1]The subalpine type was not assigned an age in the 1930s inventory.*

*[2]Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine and mixed conifer; and 140 years for lodgepole pine.*

*TABLE C-5 - 1930S INVENTORY DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE FOR SWAN RIVER STATE FOREST AND TOTAL ACRES BY COVERTYPE (THE AVERAGE REPRESENTS THE AVERAGE AGE-CLASS STRUCTURE ACROSS ALL COVERTYPES)*

| COVERTYPE | NO AGE[1] | 0 TO 39 YEARS | 40 TO 99 YEARS | 100 YEARS TO OLD STANDS | OLD STANDS[2] | TOTAL ACRES |
|---|---|---|---|---|---|---|
| | PERCENT | | | | | |
| Ponderosa pine | | 0 | 0 | 0 | 100 | 1,019 |
| Douglas-fir | 100 | 0 | 0 | 0 | 0 | 219 |
| Western larch/ Douglas-fir | | 12 | 7 | 0 | 81 | 26,253 |
| Western white pine | | 0 | 0 | 0 | 100 | 3,159 |
| Lodgepole pine | | 36 | 64 | 0 | 0 | 1,801 |
| Mixed conifer | 5 | 0 | 18 | 2 | 74 | 1,345 |
| Subalpine fir | 31 | 0 | 1 | 21 | 47 | 4,588 |
| Average | 5 | 10 | 8 | 3 | 74 | 38,668 |

*[1]The nonage category represents land that was not typed as to age in the 1930s inventory.*

*[2]Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine, and mixed conifer; and 140 years for lodgepole pine.*

*TABLE C-6 - CURRENT SWAN RIVER STATE FOREST DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE*

| COVERTYPE | NO AGE[1] | 0 TO 39 YEARS | 40 TO 99 YEARS | 100 YEARS TO OLD STANDS | OLD STANDS[2] | TOTAL ACRES |
|---|---|---|---|---|---|---|
| | PERCENT | | | | | |
| Ponderosa pine | | 43 | 9 | 11 | 37 | 2,440 |
| Douglas-fir | | 13 | 41 | 20 | 26 | 591 |
| Western larch/ Douglas-fir | | 30 | 24 | 10 | 36 | 7,637 |
| Western white pine | | 21 | 2 | 16 | 61 | 4,274 |
| Lodgepole pine | | 7 | 73 | 20 | | 2,255 |
| Mixed conifer | | 11 | 12 | 23 | 54 | 17,257 |
| Subalpine fir | | 10 | 19 | 20 | 51 | 3,282 |
| Average | | 18 | 18 | 18 | 46 | 37,736 |

*[1]The nonage category represents land that was not typed as to age in the 1930s inventory.*

*[2]Stands were considered old if they were over 170 years for ponderosa pine, Douglas-fir, and western larch/Douglas-fir; 180 years for western white pine, subalpine, and mixed conifer; and 140 years for lodgepole pine.*

*Other covertypes not included in the table: hardwoods (40 acres), nonstocked (706 acres), and nonforested (920 acres).*

*TABLE C-7 - CURRENT PROJECT AREA DATA FOR PROPORTIONAL AGE-CLASS STRUCTURE BY COVERTYPE AND TOTAL ACRES BY COVERTYPE*

| COVERTYPE | NO AGE | 0 TO 39 YEARS | 40 TO 99 YEARS | 100 YEARS TO OLD STANDS | OLD STANDS | TOTAL ACRES |
|---|---|---|---|---|---|---|
| | PERCENT | | | | | |
| Ponderosa pine | | 82 | 0 | 0 | 18 | 137 |
| Douglas-fir | | 15 | 19 | 66 | 0 | 59 |
| Western larch/ Douglas-fir | | 25 | 24 | 10 | 41 | 2,289 |
| Western white pine | | 11 | 0 | 15 | 74 | 653 |
| Lodgepole pine | | 4 | 53 | 43 | 0 | 199 |
| Mixed conifer | | 4 | 6 | 10 | 80 | 5,312 |
| Subalpine fir | | 18 | 7 | 28 | 47 | 1,735 |
| Average | | 12 | 11 | 14 | 63 | 10,384 |

FIGURE C-4 - HISTORIC AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST

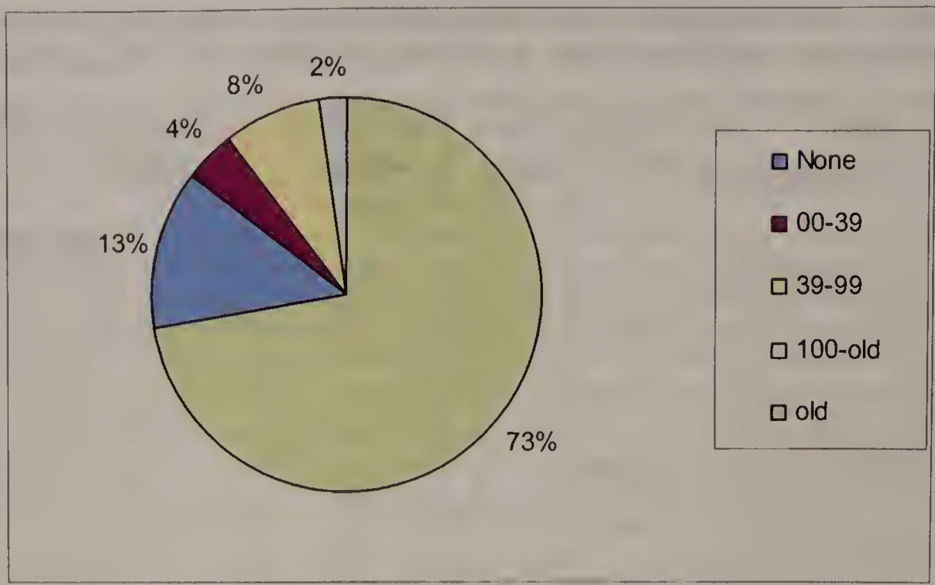



FIGURE C-5 - CURRENT AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST

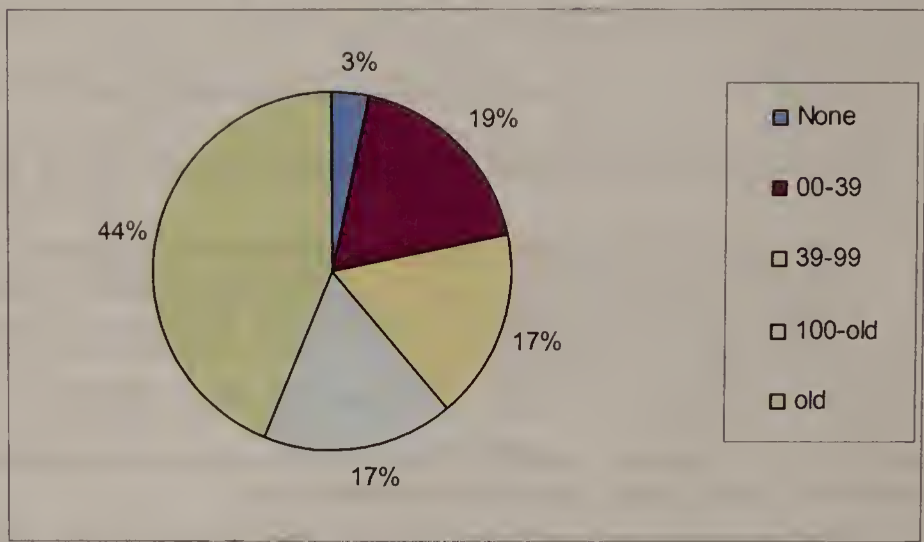



FIGURE C-6 - CURRENT AGE-CLASS DISTRIBUTION FOR THE PROJECT AREA

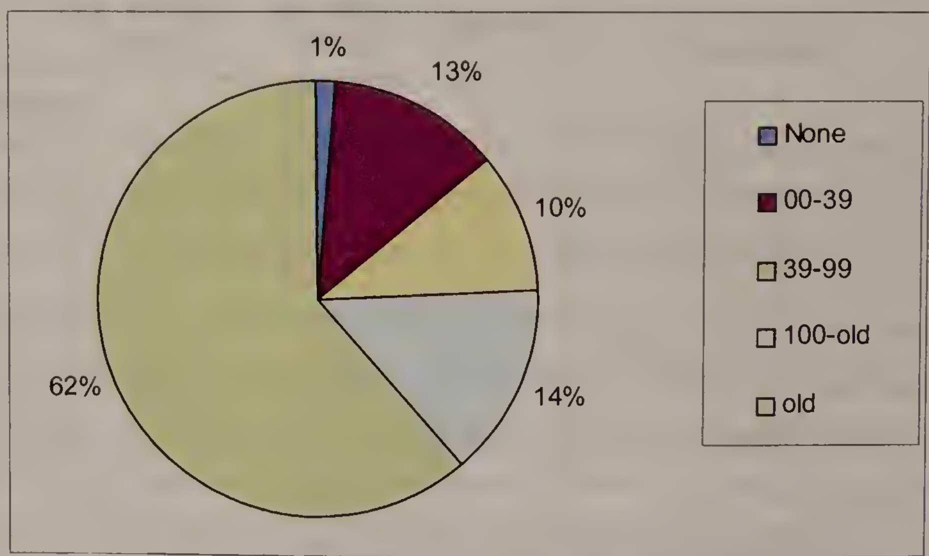
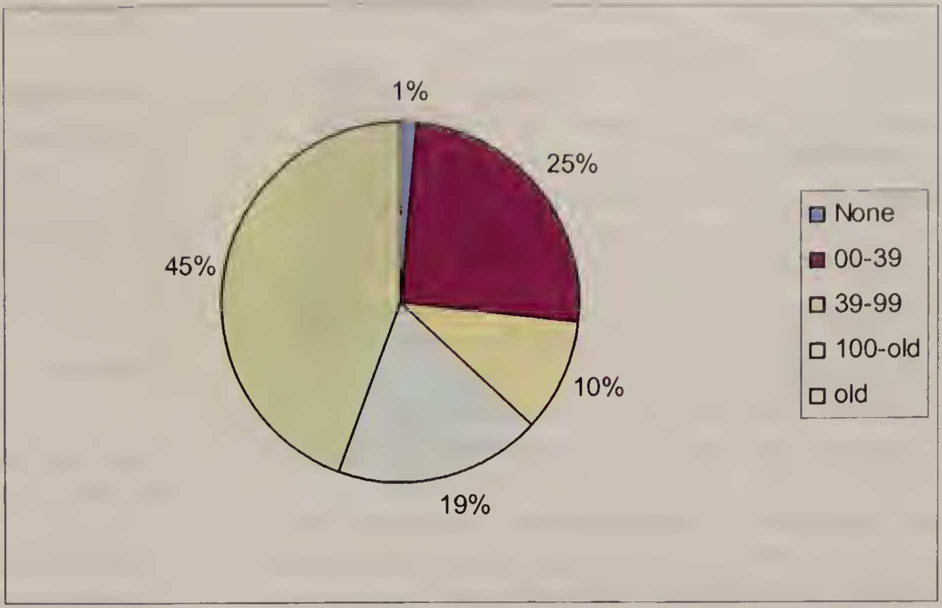


*FIGURE C-7 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B*




The proportions of older stands have decreased when compared to historic conditions. While some of the apparent decrease amounts of old stands reflects differences in data collection and mapping protocols, the data likely reflects a real decrease, though a relatively smaller decrease than suggested by the data. The historic data indicates Swan River State Forest had avoided any major disturbances for a considerable time period. While lower amounts are shown in old stands, higher amounts are in all other age-class categories.

## *ALTERNATIVE EFFECTS*

### Direct Effects

- ***Direct of No-Action Alternative A to Covertypes and Age Classes***

  In the short term, the amount of western larch/Douglas-fir and western white pine covertypes would remain lower than DNRC's desired future condition suggests (*FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOEST* and *C-3 - DESIRED FUTURE CONDITION BY COVERTYPE ON SWAN RIVER STATE FOREST*). Shade-tolerant species would continue to regenerate under closed-canopy forests, increasing the ladder fuels available to carry fire to the overstory and competing with the overstory for water and nutrients. The long-term effects on covertype would continue, with a gradual loss of the seral-dominated covertypes, such as western larch/Douglas-fir and western white pine, and an increase in the mixed-conifer covertype, which is dominated by shade-tolerant species.

  No immediate change in the proportion of existing age classes (*FIGURE C-4 - HISTORIC AGE-CLASS DISTRIBUTION FOR SWAN RIVER STATE FOREST*) is expected unless a large disturbance, such as a wildfire, occurs.

- ***Direct Effects of Action Alternative B to Covertypes and Age Classes***

  This alternative proposes regeneration harvests on approximately 1,331 acres using shelterwood, seedtree, and seedtree-with-reserves treatments, and commercial thinning on approximately 553 acres.

  Approximately 613 acres of the mixed-conifer covertype would be converted to a western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red-cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western

white pine. An additional 494 acres of the mixed-conifer covertype and 650 acres of the western larch covertype would be harvested, but no change in covertype is expected. The proportion of the western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. Approximately 127 acres within the western white pine covertype would be harvested; no change in covertype would be expected. Douglas-fir, subalpine fir, ponderosa pine, and lodgepole pine covertypes should not experience any proportional changes.

The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,331 acres; of this, 1,060 acres would be converted from the old-stand age class to the zero-year age class; the remaining 271 acres would be converted from the 100-to-150-year age class to the zero-year age class.

The 553 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in the 100-to-150-year age class, thus converting 415 acres from the old-stand age class to the 100-to-150-year age class. In addition, 6 acres would convert from the 100-to-150-year age class to the 40-to-99-year age class and 95 acres would remain in the 100-to-149-year age class following harvesting.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 0-to-39-year age class on Swan River State Forest by 3.5 percent, or 1,331 acres, while the proportion of the old-stand age class would be reduced by 3.8 percent, or 1,475 acres (*FIGURE C-7 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B*).

- ***Direct Effects of Action Alternative C to Covertypes and Age Classes***

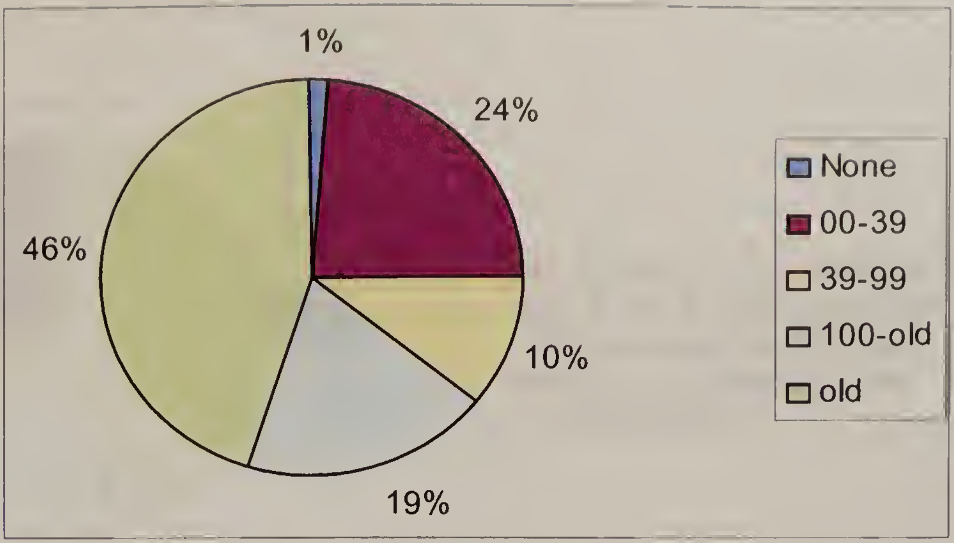
This alternative proposes regeneration harvests using shelterwood, seedtree, and seedtree-with-reserve treatments on approximately 1,253 acres, and commercial thinning on approximately 532 acres.

Approximately 660 acres of the mixed-conifer covertype would be converted to the western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red-cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 394 acres of the mixed-conifer covertype and 580 acres of the western-larch covertype would be harvested, but no change in covertype is expected. The proportion of the western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. Approximately 127 acres of western white pine and 24 acres of ponderosa pine covertypes would be harvested, but current representation should be maintained. Douglas-fir, subalpine fir, and lodgepole pine covertypes should not see any changes in percents of representation.

The proposed shelterwood, seedtree, and seedtree-with-reserves treatment would regenerate approximately 1,253 acres; 988 acres would be converted from the old-stand age class to the zero-year age class, while 266 acres would be converted from the 100-to-150-year age class to the zero-year age class.

The 532 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in

FIGURE C-8 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLCATION OF ACTION ALTERNATIVE C




the 100-to-150-year and 40-to-99-year age classes. A total of 476 acres would be converted from the old-stand age class to the 100-to-150-year age class. In addition, 6 acres would convert from the 100-to-149-year age class to the 40-to-99-year age class, and 50 acres would be retained in the 100-to-149-year age class.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 00-to-39-year age class on Swan River State Forest by 3.5 percent, or 1,253 acres, while the proportion of the old-stand age class would be reduced by 3.8 percent, or 1,464 acres (*FIGURE C-8 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE C*).

- ***Direct Effects of Action Alternative D to Covertypes and Age Classes***

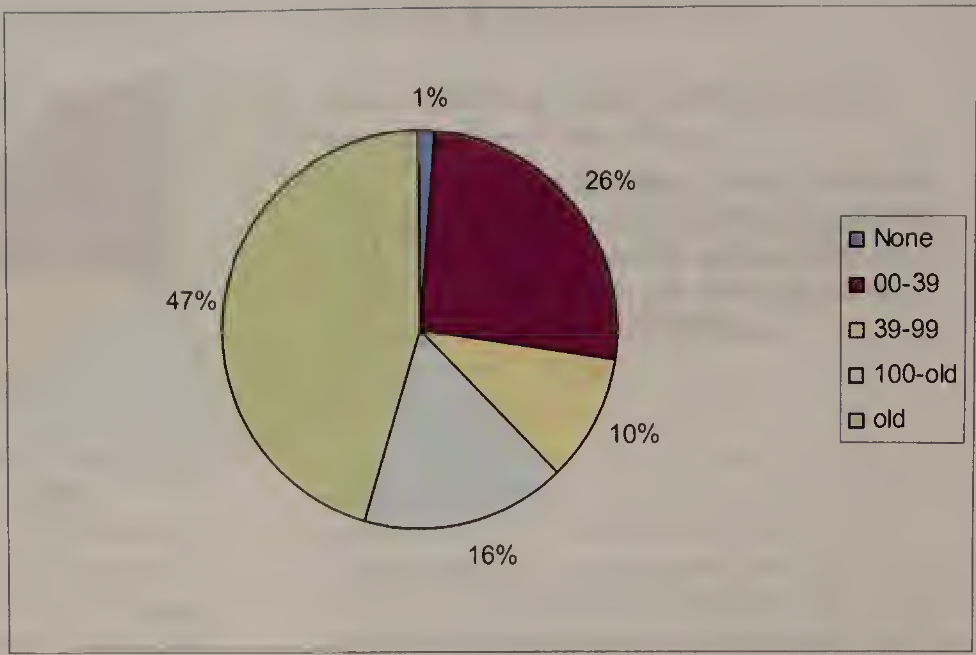
This alternative proposes regeneration harvests by using shelterwood, seedtree, and seedtree-with-reserves treatments on approximately 1,410 acres, and commercial thinning on approximately 560 acres.

Approximately 633 acres of the mixed-conifer covertype would be converted to the western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red-cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 529 acres of the mixed-conifer covertype and 595 acres of the western larch covertype would be harvested, but no change in covertype is expected. The proportion of western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. The western white pine, subalpine fir, and ponderosa pine covertype proportions should remain similar to current values, while the Douglas-fir and lodgepole pine covertypes should not experience any proportional changes.

The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,410 acres; of this, 1,055 acres would be converted from the old-stand age class to the zero-year age class, and the remaining 355 acres would be converted from the 100-to-150-year age class to the zero-year age class.

The 560 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in the 100-to-150-year and 40-99-year age classes. A total of 457 acres would be converted from the old-stand age class to the 100-to-150-

*FIGURE C-9 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE D*




year age class. In addition, 8 acres would convert from the 100-to-149-year age class to the 40-to-99-year age class, and 95 acres would be retained in the 100-to-149-year age class.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 00-to-39-year age class on Swan River State Forest by 3.7 percent, or 1,410 acres, while the proportion of the old-stand age class would be reduced by 3.9 percent, or 1,512 acres (*FIGURE C-9 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE D*).

- ***Direct Effects of Action Alternative E to Covertypes and Age Classes***

This alternative proposes regeneration harvests by using shelterwood, seedtree, and seedtree-with-reserves treatments on approximately 1,371 acres, and commercial thinning on approximately 628 acres.

Approximately 550 acres of the mixed-conifer covertype would be converted to the western larch/ Douglas-fir covertype by harvesting shade-tolerant species (grand fir, Engelmann spruce, western red cedar, et al.) and planting various combinations of western larch, ponderosa pine, and blister-rust-resistant western white pine. An additional 451 acres of the mixed-conifer covertype and 735 acres of the western larch covertype would be harvested, but no change in covertype is expected. The proportion of western larch/ Douglas-fir covertype would increase due to a combination of harvesting prescriptions and planting. The western white pine and subalpine fir covertype proportions should remain similar to current values, while the Douglas-fir, ponderosa pine, and lodgepole pine covertypes should not experience any proportional changes.

The proposed shelterwood, seedtree, and seedtree-with-reserves treatments would regenerate approximately 1,371 acres; of this, 891 acres would be converted from the old-stand age class to the zero-year age class, and the remaining 461 acres would be converted from the 100-to-150-year age class to the zero-year age class. Additionally, 19 acres would convert from the 40-to-99-year age class to the zero-year age class.

The 628 acres proposed for commercial thinning would retain pole- to sawtimber-sized trees in

the 100-to-150-year and 40-to-99-year age classes. A total of 260 acres would be converted from the old-stand age class to the 100-to-150-year age class. In addition, 211 acres would convert from the 100-to-149-year age class to the 40-to-99-year age class and 157 acres would be retained in the 100-to-149-year age class.

Regeneration treatments and subsequent planting or natural regeneration would increase the proportion of the 00-to-39-year age class on Swan River State Forest by 3.5 percent, or 1,352 acres, while the proportion of the old-stand age class would be reduced by 2.99 percent, or 1,151 acres (*FIGURE C-10 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE E*).

***FIGURE C-10 - AGE-CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE E***

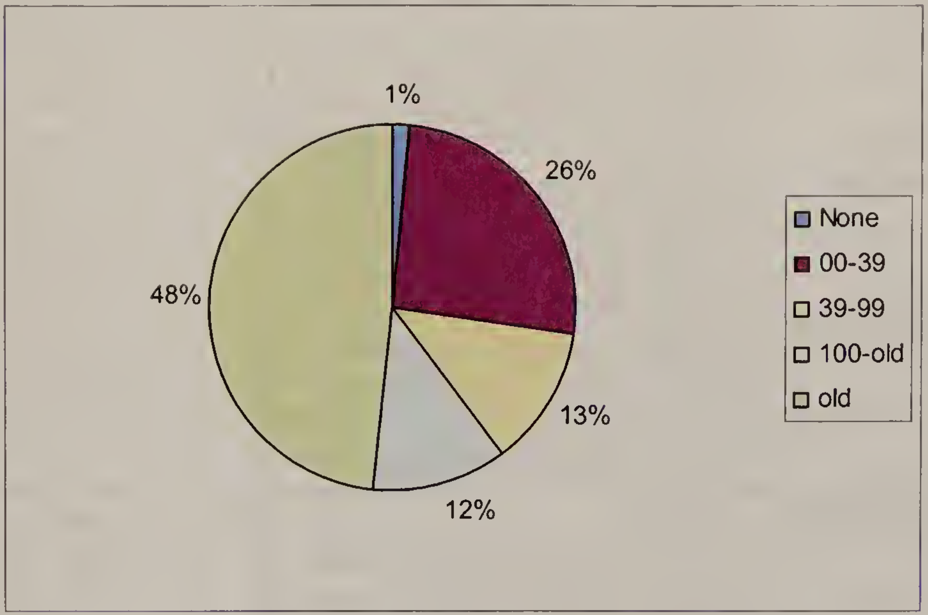


*TABLE C-8 - POSTHARVEST AGE-CLASS DISTRIBUTION, IN PERCENT, BY COVERTYPE FOLLOWING ACTION ALTERNATIVE IMPLEMENTATION*

| | | AGE CLASSES | | | | |
|---|---|---|---|---|---|---|
| | | 0 TO 39 YEARS | 40 TO 99 YEARS | 100-YEAR-OLD STANDS | OLD STAND | TOTAL ACRES |
| Western larch/ Douglas-fir | Current | 25 | 24 | 10 | 41 | 2,289 |
| | Action Alternative B | 49 | 19 | 20 | 12 | 2,867 |
| | Action Alternative C | 45 | 18 | 20 | 17 | 3,011 |
| | Action Alternative D | 48 | 19 | 19 | 14 | 2,924 |
| | Action Alternative E | 53 | 22 | 12 | 13 | 2,812 |
| Western white pine | Current | 11 | | 15 | 74 | 653 |
| | Action Alternative B | 11 | | 34 | 55 | 653 |
| | Action Alternative C | 11 | | 34 | 55 | 653 |
| | Action Alternative D | 11 | | 22 | 67 | 672 |
| | Action Alternative E | 24 | | 14 | 62 | 653 |
| Mixed conifer | Current | 3 | 6 | 11 | 80 | 5,312 |
| | Action Alternative B | 14 | 7 | 12 | 67 | 4,653 |
| | Action Alternative C | 10 | 6 | 11 | 73 | 5,312 |
| | Action Alternative D | 12 | 6 | 10 | 72 | 5,312 |
| | Action Alternative E | 8 | 9 | 7 | 76 | 5,312 |
| Subalpine fir | Current | 18 | 7 | 28 | 47 | 1,735 |
| | Action Alternative B | 18 | 7 | 28 | 47 | 1,735 |
| | Action Alternative C | 18 | 7 | 28 | 47 | 1,735 |
| | Action Alternative D | 26 | 7 | 20 | 47 | 1,735 |
| | Action Alternative E | 26 | 7 | 20 | 47 | 1,735 |
| Ponderosa pine | Current | 82 | | | 18 | 137 |
| | Action Alternative B | 82 | | | 18 | 137 |
| | Action Alternative C | 82 | | 18 | | 137 |
| | Action Alternative D | 82 | | 18 | | 137 |
| | Action Alternative E | 82 | | 18 | | 137 |

*Only affected covertypes were included on the table.*

**Indirect Effects**

- ***Indirect Effects of No-Action Alternative A to Covertypes and Age Classes***

  Forest succession, driven by the impacts of forest insects and diseases when fires are being suppressed, would reduce the variability of covertypes and age classes. As the forest ages and composition become more homogeneous, biodiversity would be reduced.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Covertypes and Age Classes***

  All action alternatives apply a variety of silvicultural treatments to stands across the project area. The types of treatments include commercial thinning, seedtree, seedtree-with-reserves, and shelterwood.

Across the project area, the forest would contain a mosaic of structures to include single-storied, two-storied, and multistoried conditions. The structure changes through harvesting would emulate fire disturbance that historically occurred within the project area. Fire disturbance emulations would range from stand replacing to mixed severity to light underburns.

Seedtree and seedtree-with-reserves harvesting would be applied under all action alternatives. This prescription emulates a stand-replacement fire because the largest share of trees would be harvested. Some fire effects would be applied when slash is piled and burned or

broadcast burned. Most regeneration would be western larch, Douglas-fir, ponderosa pine, and western white pine, which is similar to what would be expected following a fire. The majority of seedtrees retained would be the larger diameter, fire-tolerant western larch, Douglas-fir, and, where available, ponderosa pine that have some resistance to burning.

Commercial thinning treatments would be applied under all action alternatives. This prescription emulates the effects of low-intensity fires with flare-ups that are common in the mixed-severity fire regime. Harvesting would retain approximately 90 to 100 trees per acre, or 40 to 50 percent canopy coverage. The species retained would primarily consist of shade-intolerant species that move the forest towards desired future conditions for the area. Individual trees remaining in the stand would have more light and nutrients available for continued growth and vigor.

Shelterwood harvesting would occur under all action alternatives. This prescription would emulate a mixed-severity or moderate-intensity fire. Harvesting would concentrate on shade-tolerant species, individuals affected by insects or diseases, and those less desirable for the desired future conditions. Regeneration would be western larch, Douglas-fir, and ponderosa pine or western white pine where appropriate for the site conditions.

Over time, untreated stands would advance in age class and gradually shift towards covertypes with more shade-tolerant species. Treated stands would also advance in age class and, in the long term, could shift toward covertypes with more shade-tolerant species.

### Cumulative Effects

- ***Cumulative Effects of All Alternatives to Covertypes and Age Classes***

The cumulative effects of recent forest management on Swan River State Forest resulted in a trend of increasing seral covertypes across areas where management occurred. For example, the Goat Squeezer Timber Sale Project in 2003 through 2006 increased the western larch/Douglas-fir covertype on Swan River State Forest by 3 percent through timber harvesting and planting in selected units.

In addition to the changes in proportions of covertype proposed in the various action alternatives, other timber sale projects have been initiated, but not completed, and, therefore, their effects are not represented in the *swn sliwsnc20050513* data. Scheduled updates of the SLI would capture increased western larch/ Douglas-fir covertypes on Swan River State Forest, as well as the trend toward increasing acres in the 0-to-39-year age class.

The Cilly Bug Salvage Timber Sale removed dead, dying, and infected Douglas-fir and western larch. The Three Creeks Timber Sale Project would enter 2 of the stands and remove additional trees. The primary species to be harvested is grand fir, which is heavily infected with Indian paint fungus. Other permits are currently in the process of being harvested; age class or covertype of these stands would not be affected.

## CANOPY COVER

### *EXISTING CONDITION*

Canopy cover, an estimate of the ratio between tree crown area and ground surface area, is usually expressed in terms of percent and is another measure of stand stocking/ density. Categories used to describe canopy cover includes well stocked, medium stocked, poorly stocked, nonstocked, and nonforested.

The SLI database has a rating for overall canopy cover and one for sawtimber canopy cover in the stand. In terms of overall canopy cover within the project area, 72.4 percent of stands are well-stocked, 17.9 percent show medium stocking, and less than 10 percent are poorly stocked or nonstocked. Sawtimber stocking within the project area shows that 45.5 percent of stands are well stocked, while 18.7 percent of stands have medium sawtimber stocking. The poorly stocked category consists of a minor proportion of the project area and the associated stands are typically in higher elevation, which have high quantities of rock and/or brush. Timber in these stands is generally not of good merchantable quality.

### *ALTERNATIVE EFFECTS*

#### Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Canopy Cover***

  No-Action Alternative A would not change the canopy cover in the short term. Over time, individuals and groups of trees would be removed from the canopy by insects, diseases, windthrow, or fires, and result in variable changes to canopy cover as canopy gaps are created and gradually filled. Patches of variable size currently exist where the Douglas-fir beetle has killed large Douglas-fir.

  Canopy cover would likely increase over time in the absence of disturbances. Were large fires to occur, canopy cover would be reduced. Ongoing insect and disease issues would reduce canopy in some areas prior to understory reinitiation.

- ***Direct Effects of Action Alternatives B, C, D, and E to Canopy Cover***

  The reduction in canopy cover subsequent to harvest treatments would vary by action alternative and its silvicultural prescription. In general, reduced canopy cover affects stand growth and development in various ways. First, competition among the crowns of overstory trees is reduced, allowing accelerated volume growth and increased seed production. Second, competition for water and nutrients is reduced, thus allowing trees to be more resistant to both drought and bark beetle attacks. Third, a more diverse and vigorous understory is able to establish. Finally, sunlight is allowed to reach the forest floor, which, along with seedbed preparation, is of particular importance to the successful regeneration of seral species such as western larch and western white pine. For this analysis, the residual canopy cover includes both the overstory and understory tree canopies remaining after harvesting, including both merchantable and submerchantable trees.

  In areas with seedtree or seedtree-with-reserve harvesting, the canopy coverage would decrease to between 10 to 25 percent, with the exception of the reserve areas where the canopy would remain intact. In the shelterwood harvesting, the canopy would decrease to between 15 and 45 percent. Commercial thinning would decrease the canopy coverage to between 40 and 50 percent.

  Riparian stands associated with perennial streams and adjacent to a harvest unit would be treated

and experience reduced canopy coverage. The designated primary streams that would be treated are South Fork Lost, Soup, and Cilly creeks and an unnamed tributary in Section 22, T24N, R17W. A 300-foot buffer (150 feet on each side of the stream) would be identified along the primary streams where harvesting is to occur on both sides of the stream or a lack of mature timber (pole-sized or larger with a minimum of 40 percent crown closure) is on the opposite side of the stream from the harvest unit. In areas where harvesting is proposed on one side of the stream and the opposing side has mature timber, the buffer would be 100 feet. Within the buffer there would be a 25-foot no-harvest zone from the bankfull or high-water edge to 25 feet. From 25 to 150 feet (from bankfull edge), selective harvesting would occur. A maximum of 50 percent of the trees 8 inches dbh and greater may be harvested while maintaining a minimum of 40-percent overstory crown closure.

All other streams within or adjacent to a harvest unit would be managed in accordance with the SMZ law. Buffers would be 100 or 200 feet wide (50 or 100 feet each side of the stream), with a 25-foot no-harvest zone beginning at the bankfull edge.

Additionally, some harvesting would occur within the RMZ, but outside the SMZ. Small openings up to 0.25-acre in size would be allowed as long as 40-percent average canopy closure could be achieved throughout the affected area.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Canopy Cover***

  Canopy cover would increase over time as regeneration replaces the harvested trees in stands that received seedtree and shelterwood treatments. Fifteen to twenty years would be needed to develop 70- to 100-percent canopy cover.

  Canopy cover in commercially thinned stands would return to preharvest conditions in approximately 20 to 30 years, depending on the level of removal.

**FRAGMENTATION**

***EXISTING CONDITION***

Forest fragmentation refers to the breaking up of previously contiguous blocks of forest. Most often, fragmentation is used in reference to the disruption of large contiguous blocks of mature forest caused by forest-management activities such as road building and timber harvesting. In relation to fragmentation, management activities begin by putting holes in the natural forested landscape (i.e., chunks of the forest are removed via harvesting, thus creating patches of nonmature forest within a background matrix of mature forest). As management continues and more harvesting takes place, the open patches created can become connected to other open patches, thus severing the previously existing connections between patches of mature forest. While the appropriate level of fragmentation for any particular forest is unknown, forests fragmented by management activities generally do not resemble natural forest conditions.

Historically, wildfires burned with varying intensities, return intervals, and to different sizes across Swan River State Forest, which interacted with insect and disease activities to create a mosaic of forest covertypes and age classes. Today, forest management is the primary agent influencing fragmentation. Were they to occur, intense fires during extreme fire seasons would influence fragmentation across the landscape, as would insect and disease activities.

The majority of the project area exists as a contiguous forest of

well-stocked stands with closed canopies. Stands in the western part of the project area have been fragmented to some degree. Some man-made patches in harvest units range from 20 to 100 acres. Refer to *CONNECTIVITY ANALYSIS* in *APPENDIX F - WILDLIFE ANALYSIS* for an assessment of fragmentation effects on closed-canopy forests. Refer to patch size of age classes, old growth, and covertype in this analysis for additional indications of the effects of forest fragmentation.

### *ALTERNATIVE EFFECTS TO FRAGMENTATION*

#### Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Fragmentation***

  No direct effects to forest fragmentation would occur from No-Action Alternative A. Over time, and depending on an unknown future, indirect effects would include a reduction in fragmentation as additional harvesting is not imposed by management and existing patches of nonmature forest grow to maturity.

- ***Direct Effects of Action Alternatives B, C, D, and E to Fragmentation***

  For the areas proposed for regeneration harvesting, the primary effects would be creating a larger area of younger stands with a corresponding reduction in mature forest stands. In the stands designated for seedtree reserves, one or more patches (ranging in size from 1.7 to 4 acres) would be untreated, but the treatment would contribute to the fragmentation of mature forests and would reduce the distance between open- and closed-canopy stands.

  The units designated for commercial thinning would show less fragmentation of the canopy layer. Commercial-thin units would be more similar to adjacent mature stands of timber than would the regeneration harvest units and, therefore, would not contribute to fragmentation. In the case where a commercial-thin unit requires helicopter or cable systems for harvesting, the openings may resemble gaps created by small areas of crown torching that occur during low-intensity fires; however, they would not contribute to fragmentation.

#### Indirect Effects

- ***Indirect Effects of Action Alternatives B, C, D, and E to Fragmentation***

  Some regeneration harvest units are adjacent to past harvest areas and other proposed units, which would result in an enlargement of younger age-class patches. The end result would be more of a blended geometric shape of larger regeneration units. The large size of regeneration units would result in larger mature stands in the future, thus reducing fragmentation. However, future timber harvesting would result in additional fragmentation if existing mature timber patches received a regeneration harvest. The actual net effect on fragmentation would depend on future timber harvesting.

  In units where commercial-thin treatments would be accomplished, the harvesting would result in smaller differences between adjacent stands and would not contribute to fragmentation.

#### Cumulative Effects

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Fragmentation***

  An overall increase in the size of younger age-class patches and a decrease in the size of older age classes would occur where regeneration harvest units are proposed. See the discussion on age classes for acres that would change by alternative. Small Squeezer, Small Squeezer II, South Woodward, and Goat Squeezer timber

sales have added to the fragmentation of the forest. The stands that primarily contributed to fragmentation are the regeneration units. Units that involve thinning treatments did not provide harsh breaks in the canopy, but a reduced canopy cover. The aerial view shows the differences from one unit to the other from the point of stand density, but do not necessarily differ from the point of age class.

## INSECTS AND DISEASES

### *BACKGROUND*

Planning for the long-term management of forest insects and diseases is an important part of designing project-level timber sales. Various forest-species compositions and structures are more vulnerable to certain insects, diseases, windthrow, and wildfire than others (*Byler and Hagle 2000*). Identifying stands with the most vulnerable compositions and structures and developing suitable management plans can help alleviate future problems that may prevent achievement of long-term forest-management objectives.

### *ANALYSIS METHODS*

Swan River State Forest undergoes an annual aerial survey in order to map forest insect and disease problems, in particular outbreaks of the bark beetle. DNRC and USFS provide a report of the survey to Swan River State Forest; in addition to investigating these reports, DNRC personnel include their own observations of forest conditions.

The focus on the Three Creeks Timber Sale Project would include:

- the effects of insects and diseases;
- existing conditions in relation to the project or harvest areas;
- management recommendations; and
- potential losses of sawlog value to the trusts.

### *ANALYSIS AREA*

The analysis area is primarily within the Three Creeks Timber Sale Project area. The major forest insects and diseases currently affecting forest productivity include:

Diseases:

- Armillaria root disease (*Armillaria ostoyae*)
- Red-brown butt rot (*Phaeolus schweinitzii*)
- Larch dwarf mistletoe (*Arceuthobium laricis*)
- White pine blister rust (*Cronartium ribicola*)
- Indian paint fungus (*Echinodontium tinctorium*)
- Red ring rot (*Phellinus pini*)

Insects:

- Douglas-fir bark beetle (*Dendroctonus pseudotsugae*)
- Fir engraver (*Scolytus ventralis*)
- Mountain pine beetle (*Dendroctonus ponderosae*)

➤ ***Armillaria Root Disease***

Armillaria root disease, caused by the fungus *Armillaria ostoyae,* is a common pathogen of conifers in western North America. Stands impacted by Armillaria root disease occur throughout the Three Creeks project area.

*Armillaria ostoyae* spreads mainly via root contacts, but also through a short distance growth of rhizomorphs through soil (*Redfern and Filip 1991*). The fungus colonizes the root collar, kills the cambium, and eventually girdles the tree, which causes mortality. Viable *Armillaria ostoyae* inoculum can persist in below-ground portions of stumps and large roots for decades (*Roth et al. 1980*). Conifers exhibit variations both in response to infection by *Armillaria ostoyae* (*Robinson and Morrison 2001*) and

susceptibility to mortality (*Hadfield et al. 1986*). Species susceptibility and damage ratings for Armillaria root disease in western Montana are:

- severe damage: Douglas-fir, grand fir, subalpine fir
- moderate damage: ponderosa pine, lodgepole pine, western white pine
- infrequent damage: western larch and western red cedar.

Western larch, in particular, shows increasing resistance to *Armillaria* beyond age 15 (*Morrison et al. 1991*) and is colonized by root lesions less frequently than comparably aged Douglas-fir (*Robinson and Morrison 2001*). All conifers should, however, be considered equally susceptible to *Armillaria ostoyae* before ages 15 to 20 (*Hadfield et al. 1986; Morrison et al. 1991*).

Silvicultural approaches that emphasize seral species are recommended even for stands with low levels of Armillaria root disease (*Filip and Goheen 1984; Morrison and Mallett 1996*). Selective cutting in such stands is the least favorable option as it would likely result in an increased inoculum load in the form of *Armillaria ostoyae*-colonized root systems, dispersed among the remaining crop trees (*Morrison et al. 2001; Morrison and Mallett 1996*). In mixed-species stands composed of shade-intolerant, early-seral species and shade-tolerant, late-successional species, the seral species should be favored during intermediate stand entries in order to limit the root-to-root pathways between more readily damaged species. In stands where root disease is a factor, natural regeneration should be utilized, if possible, because planted trees seldom show the resistance displayed by naturally regenerated trees (*Morrison et al. 2000; Rizzo et al. 1995*).

➢ ***Western Larch Dwarf Mistletoe***

Western larch dwarf mistletoe, caused by *Arceuthobium laricis*, is considered the most important disease of western larch in the Inland West (*Beatty et al. 1997*). Dwarf mistletoes are parasitic plants that obtain moisture and nutrients from their hosts, resulting in a reduction in tree vigor, growth, and seed production. Infections greatly decrease the growth of western larch; 10-year, basal-area growth of trees in western Montana classed as lightly, moderately, and heavily infected was decreased 30, 42, and 65 percent, respectively, compared to that of an uninfected western larch (*Pierce 1960*).

The life cycle of dwarf mistletoe is generally 4 to 6 years in length, depending on the species. Dwarf mistletoes spread when seeds from the female mistletoe plants are forcibly dispersed, often for 10s of feet, in the late summer and fall; seeds that land on susceptible hosts germinate the following spring and infect the host tissues. Infections on western larch eventually cause branches to form dense clumps of twigs and branches known as "witches' brooms". In western larch these brooms are brittle and prone to break off under snow load, thus leading to gradual, top-down decline of the tree as more and more branches are lost. In addition, infection by dwarf mistletoe increases moisture stress in its host, more so when a drought is in progress, adding to the likelihood of top-down decline and attack by wood borers (Gibson 2004).

Incidence and severity of western larch dwarf mistletoe appears to be highly variable across the Three Creeks Timber Sale Project

area. This variation most likely reflects a complex history of mixed-severity and stand-replacing fires in these forests. Such fires would variously leave both mistletoe-infected and noninfected trees to provide seed for the next generation. Depending on the spatial distribution of infected, seed-bearing trees following fires, western larch regeneration might: 1) remain free of infection, 2) have a substantial lag-time prior to infection, or 3) become infected early in development. The earlier a tree becomes infected by dwarf mistletoe, the greater the impacts.

Due to the seeding habit of dwarf mistletoes, spread and intensification are at their worst when an infected overstory exists over the regeneration of the same tree species. Seedtree or shelterwood treatments can still be carried out in stands that have dwarf mistletoe infections in the overstory, but tree selection in such instances needs to discriminate against the most heavily dwarf-mistletoe-infected western larch and leave as many noninfected or lightly-infected trees as possible (*Beatty et al. 1997*).

To minimize dwarf mistletoe infection in larch regeneration, the infected overstory trees should be removed or killed once western larch regeneration is established and before regeneration reaches the age of 7 years old or 3.3 feet in height (*Mathiasen 1998*).

- ***White Pine Blister Rust***

Western white pine has declined as a component of the mixed-conifer forest in which it occurred historically on Swan River State Forest. The primary cause is white pine blister rust, a disease caused by the nonnative fungus *Cronartium ribicola*, which can infect and kill white pine of all ages and sizes. Dominant or co-dominant western white pine that are infected are often top-killed since the fungus first infects needles before growing down the infected branch and, eventually, girdling the bole. The portion of crown above such a bole infection will die once the stem is girdled.

Some western white pine remain on Swan River State Forest because either they possess natural genetic resistance to the rust or have not been infected. Retention of various numbers of mature, seed-bearing western white pine is encouraged in order to maintain genetic diversity of the species and promote natural regeneration where possible (*Schwandt and Zack 1996*). Once mature western white pine are top-killed by rust, however, their seed-producing capacity is often very limited or eliminated, and such trees can then be considered for salvage or retention as snags (*Schwandt and Zack 1996*).

Western white pine are susceptible to attack by the mountain pine beetle (*Dendroctonus ponderosae*), even when existing as relatively isolated individuals or small groups in mixed-conifer stands; damage from this bark beetle is chronic in the Inland Empire.

Management and restoration recommendations for western white pine emphasize planting rust-resistant western white pine seedlings and maintaining white pine genetic diversity (*Fins et al. 2201*).

The monitoring of rust levels should be performed at various times in the life of a stand; bole pruning to reduce the chances of blister rust infections may be required if rust levels are high when the stand is young.

### *Indian Paint Fungus*

Indian paint fungus, so called because Native Americans used the brick-red interior of the fruiting body in making pigment, is a true heartrot that very commonly infects true firs and hemlocks. This fungus is the predominant cause of heartrot and volume losses in these species in western North America (*Hansen and Lewis 1997*). True heartrots, generally confined to the heartwood of trees, consistently produce fruiting bodies or conks on the stems of living trees and do not rely on mechanical wounding as their principal infection court (*Ethridge and Hunt 1978*). Large diameter grand fir with decay caused by Indian paint fungus are important habitat, both while standing and down, for various species of cavity-nesting birds and mammals (*Bull et al. 1997*).

Trees are infected with *Echinodontium tinctorium* spores via very small branchlet stubs. The spores germinate before the infection goes dormant after being overgrown by the tree, and can then stay dormant for decades (*Maloy 1991*). Heaviest infections tend to occur in advanced regeneration growing under an infected overstory. Growth of the fungus is reactivated when the tree is wounded either naturally or mechanically, develops frost cracks, or is otherwise physiologically altered. The fungus causes extensive decay of the heartwood and, over time, these trees become more susceptible to stem collapse. A rule of thumb is that one conk on the stem of a tree indicates approximately 16 feet of extensive heartwood decay in either direction, while several conks on the stem of a tree indicate that the tree is a cull. In the Three Creeks Timber Sale Project area, Indian paint fungus is well distributed on grand and subalpine firs. Stand exams and reconnaissance surveys reveal a 30- to 40-percent infection rate. To reduce losses from this pathogen, management recommendations include (*Filip et al. 1983*):

- keeping rotations of susceptible species under 150 years unless the amount of infection is light;
- thinning early;
- selecting the most vigorous nonwounded trees for residuals; and
- minimizing wounding of susceptible hosts when thinning, prescribed burning, or performing any silvicultural treatments.

### *Red-Brown Butt Rot*

Red-brown butt rot is caused by the root-infecting pathogen *Phaeolus schweinitzii*. Any conifer can be a host, but infection is considered of primary importance in Douglas-fir. Instead of affecting trees in groups, as do root diseases such as Armillaria root disease, red-brown butt rot tends to affect trees on an individual basis (*Hansen and Lewis 1997*). The fungus can, however, cross from tree-to-tree at root grafts and contacts. Most damage occurs in stands more than 80 years of age. The pathogen infects via small roots and causes decay in the interior of the roots. This decay extends into the butt log an average of eight feet, making such trees susceptible to stem collapse and windthrow. Since most are green when windthrown, the trees provide prime habitat for Douglas-fir and other bark beetles. Management options are limited. Rotations can be shortened to about 90 years in Douglas-fir to minimize loss due to decay, and less-affected host species can be emphasized over Douglas-fir.

### Douglas-Fir Bark Beetle

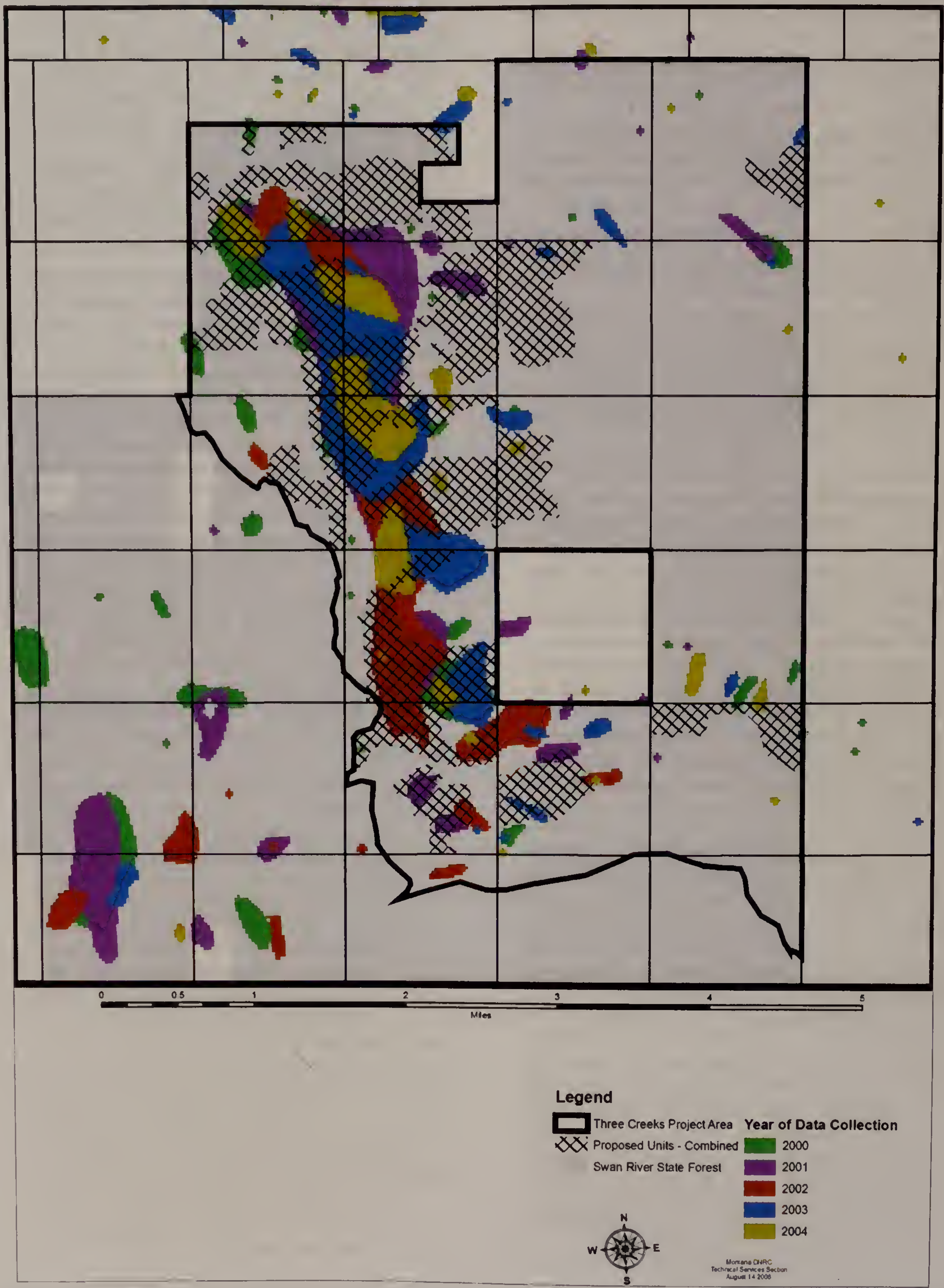
The Douglas-fir bark beetle has been active in recent years across Swan River State Forest. The project area has an elevated incidence of the Douglas-fir bark beetle in areas proposed for harvesting. In general, stands that are at highest risk to attack by the Douglas-fir bark beetle are those with (*USDA Forest Service 1999)*:

- basal areas greater than 250 square feet per acre;
- an average stand age greater than 120 years;
- an average dbh greater than 14 inches; and
- A stand composition greater than 50-percent Douglas-fir.

Douglas-fir within most of the proposed harvest areas on the Three Creeks Timber Sale Project area are at high risk of Douglas-fir bark beetle attack due to age, size, and stocking. Low, or endemic, populations of Douglas-fir bark beetles tend to exist in fresh blowdown, fire-killed trees, or live trees within and around pockets of root disease (*Livingston 1999; Schmitz and Gibson 1996*). Management of the Douglas-fir bark beetle should concentrate on the removal of windthrown Douglas-fir and the salvage of newly attacked trees before adult beetles can emerge (*Livingston 1999; Schmitz and Gibson 1996*). Valuable Douglas-fir (e.g. those in and around campgrounds) that are considered to be at high risk can be protected by use of the Douglas-fir bark beetle anti-aggregant pheromone 3-methylcyclohex-2-en-1-one (*Ross et al. 2001*).

Numerous pockets of infestations were located within the analysis area in 1999. Each spring following the flight of the beetle, reconnaissance surveys were conducted by DNRC foresters to determine the extent of infestations. (See *Figure C-11 - DOUGLAS-FIR BEETLE ACTIVITY 2000 THROUG 2004 IN THE VICINITY OF THE THREE CREEKS TIMBER SALE PROJECT, ALL ALTERNATIVES COMBINED*) The beetle was estimated to have caused heavy Douglas-fir mortality on approximately 2,500 acres. The Swan River State Forest timber permit program allowed for the salvage harvesting of approximately 2 mmbf of sawlogs in 1999, 600 mbf in 2000, and 500 mbf in 2001.

*FIGURE C-11 - DOUGLAS-FIR BEETLE ACTIVITY 2000 THROUGH 2004 IN THE VICINITY OF THE THREE CREEKS TIMBER SALE PROJECT, ALL ALTERNATIVES COMBINED*



- ***Fir Engraver***

The fir engraver, *Scolytus ventralis*, has recently killed many grand and subalpine firs in the Swan Valley. This bark beetle is wide-ranging across the west, attacking primarily grand fir (*Ferrell 1986*). Endemic populations of fir engraver beetles are closely associated with root disease or other factors that stress its hosts; they rarely make successful attacks on vigorous grand fir (*Goheen and Hansen 1993*). However, when grand fir and other preferred hosts become stressed during periods of drought, the fir engraver can begin attacking otherwise healthy trees across the landscape, and the association with root disease becomes less distinct (*Goheen and Hansen 1993*).

Management of the fir engraver is problematic. Silvicultural practices that promote the vigor of grand fir stands - thinning, for example - would also reduce the chances of extensive damage during periods of drought (*Ferrell 1986*). Management practices aimed at reducing the impact of root diseases would also help lessen the long-term impacts of the fir engraver. Such practices include the promotion of less root-disease-susceptible species, such as western larch, western white pine, and ponderosa pine, in areas with extensive root disease.

- ***Mountain pine beetle***

Mountain pine beetle (*Dendroctonus ponderosae*) is a native North American bark beetle with four major hosts, one being western white pine (Amman et al. 1989). Historically, when extensive stands of mature western white pine still existed, mountain pine beetle outbreaks could kill a large majority of trees just as the mountain pine beetle does today in extensive stands of lodgepole pine. The occurrence of pitch tubes along the bole is one way to determine if attacks by mountain pine beetles have occurred. Pitch tubes on successfully attacked trees are generally very numerous, one-fourth to one-half inch in diameter and consist of cream- to dark-red-colored masses of resin mixed with frass. Pitch tubes on unsuccessfully attacked trees are widely scattered over the bole of the tree, three-quarters to one inch in diameter, and mostly cream-colored. Confirmation of a mountain pine beetle attack can be done by looking for the characteristic gallery patterns on the inner side of the bark. Bark beetles attacking western white pine also introduce aggressive blue-stain fungi that grow into the sapwood and contribute to the death of the tree.

Mountain pine beetles produce one generation per year, though sometimes pupae or brood adults will last longer at higher elevations. The beetles overwinter mostly as larvae within the egg galleries, then maturate and emerge as adults to attack more trees from June through August. The foliage of trees that have been successfully attacked during the current year can change color anywhere from a few months to a year later. Therefore, mountain pine beetle brood trees attacked the previous summer and removed during late winter or spring salvage operations may still have green foliage.

## ***ALTERNATIVE EFFECTS TO INSECTS AND DISEASES***

### Direct Effects

- ***Direct Effects of All Action Alternatives to Insects and Diseases***

Harvest treatments would target those species or individuals affected by insects and diseases, as well as the salvage of recently killed trees. Douglas-fir

currently or recently infested by the Douglas-fir bark beetle would be removed when merchantable value exists. Western larch with the most severe infections of dwarf mistletoe would be harvested. Other species that would be discriminated against in harvests include grand fir and subalpine fir. By removing green infected trees, the continued spread of the various insects and diseases would be hampered.

Direct effects of the harvest treatments are the removal of trees affected by insects and diseases, those with reduced growth rates due to age, and shade-tolerant trees that do not help meet desired future conditions. Seedtrees, primarily western larch, would be left scattered throughout the harvest units to provide a seed source for natural regeneration.

Insect and disease problems would be reduced following implementation of any action alternative. Action Alternative B does the most to control rates of spread, economic value loss, and volume loss within the project area. The other action alternatives in order of decreasing efficacy in treating insect and disease activity would be Alternative D, C, and E.

- ***Direct Effects of Action Alternative B to Insect and Disease***

Units proposed for harvest under this alternative are moderately to heavily affected by insect and disease activities. Treatments are focused on those stands with the greatest amounts of mortality and economic value loss. Treatments would remove merchantable dead timber, green timber affected by insects and diseases, those with reduced growth rates due to age, individual trees considered at risk of infection, and the less desirable shade-tolerant species that are more susceptible to insect and disease problems.

The majority of the units would be treated with regeneration harvests, but some commercial thinning would be applied. Regenerating species would be shade-intolerant species, such as western larch, that are more resistant to many of the infecting agents currently present. This alternative does the most to address insect and disease problems in the project area.

- ***Direct Effects of Action Alternative C to Insect and Disease***

Many of the stands selected for this alternative have insect and disease activities occurring at elevated levels. Emphasis would be placed on trees (groups or individuals) that are affected by insects or diseases, are at risk of infection, or, if dead, contain merchantable material. In units utilizing a regeneration harvest, seedtrees would remain scattered throughout to provide a seed source; these seedtrees would primarily be shade-intolerant species, such as western larch, that have a higher tolerance to insects and diseases. Fewer acres receive regeneration harvests with this alternative, reducing the control of insect and disease problems, compared to Action Alternative B. Units proposed for harvesting under this alternative are moderately to heavily affected by insect and disease activities. Treatments are focused on those stands with the greatest amounts of mortality and economic value loss. Treatments would remove merchantable dead timber, green timber affected by insects and diseases, timber with reduced growth rates due to age, individual trees considered at risk of infection, and the less desirable shade-tolerant species that are more susceptible to insect and disease problems.

The majority of the units would be treated with regeneration harvests, but some commercial thinning would be applied. Regenerating species would be shade-intolerant species, such as western larch, that are more resistant to many of the infecting agents currently present. This alternative does the most to address insect and disease problems in the project area.

- ***Direct Effects of Action Alternative D to Insect and Disease***

Harvesting is proposed in some stands with moderate to heavy levels of insect and disease problems, although approximately half the stands selected have low levels of insect and disease activity.

Harvest treatments would focus on the removal of trees affected by insects and diseases, those with reduced growth rates due to age, and shade-tolerant trees that do not meet desired future conditions. The amount of regeneration harvesting would be intermediate between Action Alternatives B and C, with a corresponding intermediate effect on reducing insect and disease problems.

- ***Direct Effects of Action Alternative E to Insect and Disease***

The stands proposed for harvesting have moderate to heavy insect and disease activities and are in the lower elevations of the project area. An objective for this alternative was to limit the amount of old-growth stands that would be harvested. In doing so, the stands most affected by insect and disease activities would be avoided. Areas of known beetle populations and other diseases would be left untreated, which would allow the continued spread of existing insect and disease problems.

In the treated units, emphasis would be placed on the removal of trees affected by insects and diseases, those considered at high risk, and shade-tolerant species that do not meet desired future conditions. The avoidance of many stands with known insect and disease problems results in this alternative having the least effect on reducing insect and disease problems.

## Indirect Effects

- ***Indirect Effects of All Alternatives to Insects and Diseases***

Where shelterwood and commercial-thin treatments are applied, an indirect effect would be increased vigor and growth rates of the remaining trees due to the availability of light, nutrients, and moisture. Following treatment, the species composition would be more resilient to damage by forest diseases and insects.

Rust-resistant western white pine, western larch, and, in some cases, ponderosa pine would be planted in units utilizing seedtree harvest treatments. The white pine seedlings would increase a declining component on Swan River State Forest. The planting of western larch would help reduce the likelihood of future insect and disease problems due to its lower susceptibility to many of the problems being addressed.

Under Action Alternative B, the newly established stands would be healthier and the overstory would not be laden with insect and disease activities that would infect/infest the seedlings. This alternative would also treat the most acres with insect and disease problems, which, in turn, would lead to healthier forest stands for the future.

Action Alternatives C and D also propose harvesting insect-infested and disease-infected stands. These alternatives would not treat

as many acres as Action Alternative B, but would have similar effects on the acres that were treated. Overall, these alternatives would do less than Action Alternative B to address the insect and disease problems prevalent in the project area.

Action Alternative E would do the least to address insect and disease problems in the project area. Treatments in stands currently affected by insect and disease problems would provide benefits to the newly developed stands. Treated stands that do not have current problems may be more resistant to future insect and disease activities. However, the avoidance of known insect and disease hotspots would provide a dissemination source, which would increase the future spread of insect and disease problems, when compared to the other alternatives.

### Cumulative Effects

- ***Cumulative Effects of All Alternatives to Insects and Diseases***

  Timber-management activities on Swan River State Forest have generally implemented prescriptions that would reduce losses and recover mortality due to stem rots, bark beetles, white pine blister rust, western larch dwarf mistletoe, blowdown, and other causes. Stand-regeneration treatments are producing stands with species compositions more resilient to the impacts of forest insects and diseases and more in line with historic forest conditions. Thinning treatments have further reduced the percentage of infected or infested trees.

  The cumulative effects of these treatments are shown in *FIGURES C-7 (8, 9, 10) - AGE CLASS DISTRIBUTION WITHIN THE PROJECT AREA FOLLOWING APPLICATION OF ACTION ALTERNATIVE B (C, D, E)*, where the increase in the 0-to-39-year age class is a result of silvicultural treatments. Older trees are the most susceptible to many of the identified insect and disease problems in the project area.

## FIRE EFFECTS

### *SWAN RIVER STATE FOREST HISTORY*

The fire regime across Swan River State Forest is variable. The forest displays a mosaic pattern of age classes and covertypes that have developed due to variations in fire frequency and intensity. In areas that have experienced relatively frequent fires, Douglas-fir, western larch, and ponderosa pine covertypes, with a component of lodgepole pine and western white pine, were produced. As fire frequencies become longer in time, shade-tolerant species (grand fir, subalpine fir, Engelmann spruce, western hemlock, western red cedar) have a better chance to develop. Higher elevation sites within the forest have longer fire frequencies, and the resultant stands are multistoried with a dominant shade-tolerant covertype. Where fire frequencies were short, the stands are open and single storied, occasionally two storied. As fire suppression began, covertypes and fire frequencies were altered. Stands of ponderosa pine, western larch, and/or Douglas-fir have become multistoried with shade-tolerant species. Ponderosa-pine-dominated stands that were once open now have a thick understory of Douglas-fir. Fires that do occur are generally kept small and natural fire effects are limited. If a larger scale fire were to start, many acres could be affected due to ladder fuels, heavy fuel accumulation, and other environmental factors.

Swan River State Forest has identified 67 fires over the last 25 years. Over the last 25 years, 48 lightning fires have burned 98.5

acres, with the largest occurring in 1994 during a dry lightning storm; that fire burned 65 acres in the upper subalpine fir habitat types. Lightning causes approximately 72 percent of all fire starts on Swan River State Forest. On average, 2.68 fires per year occur; approximately 2 are from natural events and 1 is human-caused. Human-caused fires are typically started from campfires, debris burning, or incidents directly related to powerline sparks. Within the project area, an average of 1 fire per year occurs and is usually caused by lightning. (*Personal communication Allen Branine, 2006*).

Past research has been conducted that looked at fire history within the Swan valley. The following summaries describe the fire history and the patterns they created on the landscape.

*Hart (1989)* summarized the historical data as follows:

> *Although most of the burns…were of stand-replacement intensity, many less intense fires had also crept over wide areas. The upper (southern) half of the Swan valley had been extensively burned, and was blanketed by fallen trees. In this area, fires were moderate, thinning the forest. The lower (northern) Swan also was scarred by fires, but it had a great deal of older mixed forest; species typical of mesic sites were found in this region….*

*Antos and Habeck (1981)*, working mostly in the northern portion of the Swan valley, emphasized the dominance of low-frequency, high-intensity fires (stand-replacement fires) in determining stand patterns:

> *During most summers, the occurrence of frequent rain makes intense fires unlikely; but in some years, dry summers set the stage for large crown fires. Most stands were initiated on large burns…. An average frequency of replacement burns of between 100 and 200 years was characteristic…. Stands over 300 years old do occur, and repeat burns less than 20 years apart have also occurred. In some forests initiated by replacement burns, ground fires have occurred after stand establishment, with variable effects on the overstory. Very wet sites, such as stream bottoms and lower north slopes, often experience partial burns when located within the perimeter of large replacement burns.*

The analysis of fire history indicates that the lower elevations of the Swan valley were burned frequently; in the drier southern half, the intervals were shorter than on the more moist northern part. Between 1758 and 1905, this portion of the range had fire-free intervals of about 30 years, and the presence of western larch and even-aged lodgepole pine suggests the fires were of higher intensity. The remaining samples are from the southern end and these have a shorter interval of 17 years (*Freedman and Habeck, 1984*).

Historical data indicates that forests in Swan River State Forest and the project area were cooler and moister than the broad scale Climatic Section and western Montana averages. They were also considerably older with a far higher proportion of western larch/Douglas-fir covertypes than at the broad scale. Although the forests of Swan River State Forest were old, the representation of shade-tolerant covertypes was low, indicating disturbance was frequent or recent enough to prevent widespread covertype conversion through succession.

## *FIRE GROUPS*

The Three Creeks Timber Sale Project area is primarily represented by 2 different fire regimes that are classified as fire groups: Fire Group 11 and Fire Group 9 (*Fischer and Bradley, 1987*). Five other fire groups are within the project area, but due to minor representation (5 percent or less), these fire groups will not be addressed further in this document. The project file at the Swan River State Forest office contains information on the other fire groups.

Fires burned in the project area at intervals of 15 to 200-plus years. The various fire intervals and intensities created a mosaic of stands in the forest across the project area. Management in the project area is attempting to mimic, at least in part, historic fire patterns and intensities. The species representation in the project area has also been influenced by fire disturbances. Where feasible, in terms of covertypes (western larch/Douglas-fir, western white pine, etc.), treatments would attempt to move the forest toward desired future conditions and maintain these covertypes by future management activities (*FIGURE C-1 - PROPORTION OF HISTORIC CONDITIONS BY COVERTYPE FOR SWAN RIVER STATE FOREST* and *FIGURE C-2 - CURRENT COVERTYPE PROPORTIONS FOR SWAN RIVER STATE FOREST*).

The Three Creeks Timber Sale Project area is primarily represented by Fire Group 11 (62 percent of the project area), Fire Group 9 (25 percent) being the next most common, and minor representation in Fire Groups 10 (5 percent), 7 (4 percent), 6 (3 percent), 8 (2 percent), and 5 (less than 1 percent) (*Fischer and Bradley, 1987*).

The majority of the proposed stands fall into Fire Group 11, which represents a warm, moist, grand fir habitat type where fires are infrequent but severe, and the effects are typically stand replacing. Fire-free intervals range from 100 to 200 years between stand-replacing fires. This fire group has predominately moist conditions, which can allow these areas to serve as a fire break for low-intensity ground fires. The sites are also known to have high fuel loadings, high plant productivity, and, when combined with drought conditions, these lead to severe and widespread fires.

The next common fire regime in the project area is Fire Group 9, which is characterized by moist, lower subalpine habitat types where fires are infrequent, but severe, and the effects may be long lasting. Past studies show an average fire-free interval of 30 years, with extremes of 10 to 100 years. The dominant representation of ponderosa pine, western larch, and Douglas-fir reflects the relatively high fire frequency. Due to the moisture content of these stands, moderate to severe fires may have been restricted to brief periods in the summer. Flare-ups may have caused openings that allowed the establishment of seral species.

The other 5 fire groups identified in the project area are represented in lesser amounts. Fire group 10 is a cold, moist, upper subalpine fir type where fire plays a secondary role to site factors. The main influencing factors in this habitat type are climate and soils, which influence forest development on these sites. Fires are infrequent, with a range of 35 to 300 years. More pronounced effects of fire frequency are when stand-replacing fires occur at 200 years or more.

Fire group 6 is a moist Douglas-fir habitat type. Prior to European settlement, this group was a fire-maintained open forest. A typical fire interval ranged from 15 to 40 years, which maintained an open forest and kept brush at low levels.

The frequent fires would favor western larch and ponderosa pine over Douglas-fir.

Fire group 7 is a cool type often associated with forests dominated by lodgepole pine. Periodic disturbances, from low-intensity to stand-replacement fires, are common to these stands. Stand-replacement fires generally occur in 50- to 100-year cycles, but may extend to 500 years in some cases. Typically by 60 to 80 years, the stand is in a condition where an ignition source may generate a stand-replacing fire.

Fire group 8 is a dry, lower subalpine habitat type. This group falls between group 7 with a burn cycle of 50 years and group 9 with a fire frequency of 90 to 130 years. Periodic low- to moderate-severity fires favored Douglas-fir and lodgepole pine and held back shade-tolerant species like subalpine fir and Engelmann spruce.

Fire group 5 is a dry Douglas-fir site and occupies less than 1 percent of the project area. This group has short fire intervals of 35 to 45 years. These short fire intervals are typical of open forests that generate park-like stands.

### *HAZARDS AND RISKS IN THE PROJECT AREA*

The hazards and risks associated with wildfires include a potential loss of timber resources, effects to watersheds, and loss of property. The majority of timber stands being considered for harvesting are in the mature or older age classes in stands that have not burned since pre-European settlement. Fire hazards in these areas range from above- to near-natural levels with moderate to high accumulations of down and ladder fuels relative to stand densities. Some of the western larch/Douglas-fir stands have a dense understory of grand fir, a significant hazard due to its density and structure and the increased risk that a low-intensity ground fire could develop into a stand-replacing crown fire.

Many of the old-growth stands in the project area are relict stands. Stand-replacing fires have not occurred in the area for 200 or more years. As the stands continue to age and mortality occurs from various biotic and abiotic factors, fuels would accumulate. These stands have an in-growth of shade tolerant-trees, which provide ground and ladder fuels, thus increasing their susceptibility to intense fires, especially during drought. Accessible stands have had salvage logging and firewood cutting that has reduced the larger diameter down fuels in the area. The continued encroachment of shade-tolerant trees, accumulations of down woody debris, and mortality increases the fire risks.

Increased recreational use in the area is another potential ignition source that may result in a hazardous condition due to fuel accumulation.

Nonindustrial forestland adjacent to the project area has a similar amount of fuel loading. Much of the adjacent USFS ownership has not been managed for several years. The resulting stands have a moderate to high risk of stand-replacement wildfires due to continued heavy fuel loadings.

### *ALTERNATIVE EFFECTS TO FIRE EFFECTS*

#### Direct Effects

- ***Direct Effects of No-Action Alternative A to Fire Effects***

  The wildfire hazard would not change substantially in the short term. With continued fuel accumulation from downed woody debris, the potential for wildfires increases. Large-scale, stand-replacing fires may be the outcome.

- ***Direct Effects of Action Alternatives B, C, D, and E to Fire Effects***

  Immediately following timber harvesting, the amount of fine fuels would increase. Hazards would be reduced by scattering slash, cutting limbs and tops to within a maximum height to hasten decomposition, spot-piling by machine in openings created by harvesting, and burning landing piles.

  Broadcast burning would be utilized as a site preparation method in some seedtree units, while others would be treated by simultaneously piling slash and scarifying soil with an excavator, followed by the burning of piles. Scarification and broadcast burning both prepare seedbeds for natural regeneration. Broadcast burning would consume fuels and return nutrients to the soil at a faster rate than unburned areas.

### Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Fire Effects***

  Eventually, due to the continuing accumulation of fine fuels, snags, ladder fuels, and deadwood components, the risk of stand-replacement fires would increase.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Fire Effects***

  The hazards of destructive wildfires in these stands would be reduced because larger, more fire-resistant species would be left at wider spacings. Grand fir, some Douglas-fir, western red-cedar, and subalpine fir, which pose a higher crown-fire hazard because of their low growing branches and combustible nature, would be removed. This would reduce the potential mortality from low- to moderate-intensity fires, but would not "fireproof" the stands from the high-intensity stand-replacing fires brought on by drought and wind.

  Seedtree and shelterwood harvest treatments would cause wildfire hazards to be reduced. Regeneration harvests, where slash has been treated but trees are still small, have proven to be fire resistant in many cases. However, contrary conclusions have been put forth wherein timber harvesting is believed to have increased the risk of wildfires, especially in the short term, where logging slash was not treated. Fire hazards would slowly increase over time as trees reach pole size and crown densities increase and fuels accumulate.

### Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A on Fire Effects***

  The risk of wildfires would continue to increase as a result of long-term fire suppression.

- ***Cumulative Effects of Action Alternatives B, C, D, and E on Fire Effects***

  Fuel loadings would be reduced in treated stands, decreasing wildfire risks in these specific areas.

  The Goat Squeezer II and III timber sales will have a combination of broadcast burning and excavator piling and burning to be completed this fall and the following spring. Ongoing salvage sales across Swan River State Forest will also have excavator piling and burning associated with slash at the landings. The net cumulative effect would be a reduction in wildfire risks.

## OLD GROWTH

DNRC defines old growth as stands that meet minimum criteria for number, size, and age of trees per acre for a given combination of covertype and habitat-type group. The definitions are adopted from those presented by *Green et al., (1992)*. DNRC's definition has evolved over the years; previous analysis may appear to contradict the analysis presented in this DEIS because of that evolution. The multitude of diverse old-growth definitions used by various researchers, organizations, and individuals tends to further confuse the discussion of old growth, so we attempt to clarify the basis for the source of the old-growth information we present.

### *HISTORIC ESTIMATES OF OLD GROWTH*

Many previous efforts have been made to estimate the historical amounts of old growth in the Swan valley. The following approaches have been used:

- DNRC estimated the quantity of old growth that may have existed historically (*Montana DNRC 2000*); results suggested that, given the definition used in the analysis, approximately 22 percent of Swan River State Forest represents the expected amount of naturally occurring old growth. That analysis used a more restrictive definition for old growth than DNRC currently uses.
- *The Flathead National Forest (FNF) Plan Amendment 21 (1998)* estimated that 29 percent of low-elevation forests on FNF was old growth, 8 percent of mid-elevation forest was old growth and none of the high-elevation forest was old growth, as derived from historic surveys (*Ayers 1898, 1899*). Using various sources of information, the *FNF Amendment 21* also estimated that old growth in FNF had an historical range of variability from 15 to 60 percent. Using a computer modeling process, FNF estimated that approximately 36 percent of the Swan valley existed as late-seral forest; however, not all late-seral stands would qualify as old growth.
- *Lesica (1996)*, in an effort to use fire history to estimate the proportions of old-growth forests in the Swan valley, estimated that approximately 52 percent of the area was occupied by stands that were 180-years or older. *Lesica* used stand age as a surrogate for old growth in his mathematically derived estimations.
- Using covertype conditions and historical data from the 1930s (*Losensky 1997*), 29 percent of the forested acres in the Upper Flathead Climatic Section were estimated to have historically been occupied by stands 150 years and older and contained a minimum of 4 mbf/acre (*South Fork Lost Creek FEIS, 1998*). The old-stand definition from *Losensky* was previously used as DNRC's old-growth definition, adding to the confusion over old-growth reporting and discussion.
- *Hart (1989)* indicated that approximately 48 percent of the area represented in the 1930s stand data for the Seeley and Swan valleys had forests with a significant component of trees older than 200 years.

Therefore, using a wide variety of old-growth definitions, the estimates of the historic amount of old growth on Swan River State Forest suggest a range from 15 to 50 percent. The estimates above are primarily age-based estimates that do not consider the other attributes often deemed necessary to call a stand "old growth", and, therefore, old-growth amounts are overestimated compared to when it is defined with additional attribute thresholds; for example, only DNRC's estimate has any criteria related to the size and number of large trees per acre,

leading one to the conclusion that old growth would necessarily be lower than the other estimates provided because not all old stands, late-seral stands, or modeled stands would have sufficient numbers of large live trees to meet DNRC's old-growth definition.

Emphasis should be made that the estimates presented defined old growth in a variety of ways and none of them represent estimates based on the *Green et al* definitions that DNRC currently uses; most provide estimates that are higher than they would be if they included additional attribute criteria.

Based on available estimates, the amount of old growth on Swan River State Forest is currently within the historically occurring range.

***ANALYSIS METHODS***

DNRC uses criteria set forth in *Green et al. (1992)* to define old growth. The definition sets minimum thresholds for the number and size of large trees based on habitat type and covertype. The SLI data categorizes many stands within the project area as old growth. As part of the field reconnaissance for this project, stands identified as old growth via the SLI data, or those in question, were field-checked to verify that they meet DNRC's definition.

***EXISTING OLD-GROWTH DISTIBUTION***

Swan River State Forest currently has 12,478 acres of old growth, which is equal to 32.4 percent of the total acreage. The project area contains 4,483 acres of old growth, which is equal to 42.2 percent of the project area. Old-growth acreages may change as field surveys are completed and the SLI database is updated. *TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST* shows the amount of acres in old-growth status per covertype according to the current SLI database information. The current analysis also looks at the old-growth spatial distribution to analyze the effects of a proposed action.

*TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST* presents total acres of old growth by forest type. Covertypes reflect the interactions of disturbance history, species requirements for regeneration, physiography, and availability of a seed source. The old-growth definitions used by DNRC are expressed in terms of covertype, thus allowing comparisons to *Losensky's (1997)* historic information for amounts of old-age stands. Mixed conifer, western larch/Douglas-fir, and western white pine (*TABLE C-3 - CURRENT AND*

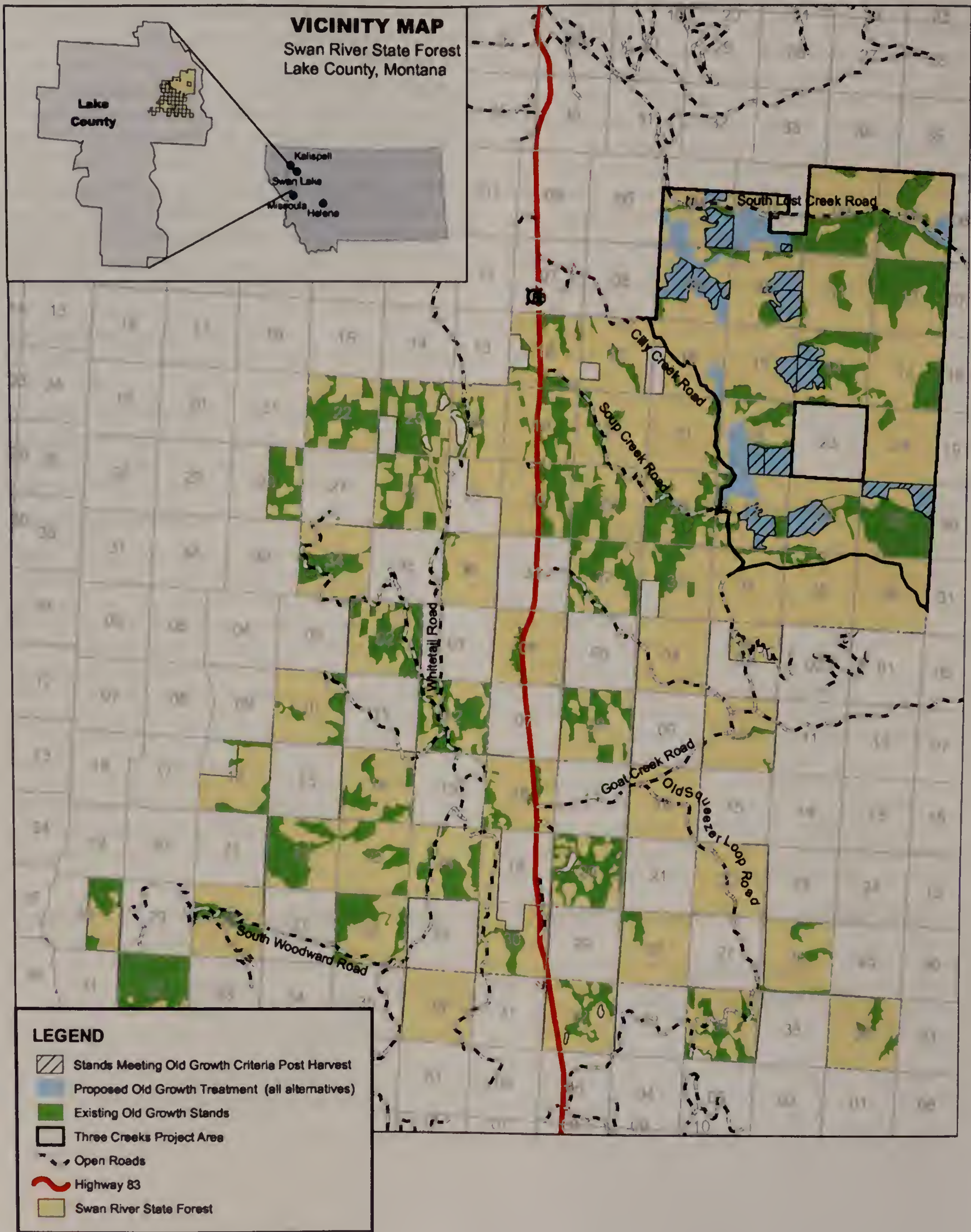
***TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST***

| OLD-GROWTH TYPE | OLD-GROWTH ACRES | POSTHARVEST ACTION ALTERNATIVE | | | |
|---|---|---|---|---|---|
| | | B | C | D | E |
| Douglas-fir | 8 | 8 | 8 | 8 | 8 |
| Western larch/Douglas-fir | 1,830 | 1,968 | 1,901 | 1,960 | 1,710 |
| Western white pine | 2,016 | 2,016 | 2,016 | 2,016 | 2,016 |
| Mixed conifer | 6,926 | 6,253 | 6,397 | 6,200 | 6,699 |
| Subalpine fir | 1,114 | 1,114 | 1,114 | 1,114 | 1,114 |
| Lodgepole pine | 0 | 0 | 0 | 0 | 0 |
| Ponderosa pine | 584 | 584 | 584 | 584 | 584 |
| Totals | 12,478 | 11,943 | 12,020 | 11,882 | 12,131 |

*POSTHARVEST STAND STRUCTURE OF UNITS PROPOSED FOR HARVEST IN THE THREE CREEKS PROJECT AREA*) are currently the 3 dominant old-growth types on Swan River State Forest. The increase in acres of specific old-growth types shown in *TABLE C-9 - CURRENT OLD-GROWTH ACRES AND ALTERNATIVE EFFECTS BY FOREST TYPE FOR SWAN RIVER STATE FOREST* occurs as a result of commercial-thin and shelterwood treatments, where sufficient large live trees are retained to meet DNRC's old-growth definition, but removal of certain species of trees results in a reclassification of the "type" of old growth.

*FIGURE C-12 - CURRENT OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST* is a map of old growth within the project area. In addition to old-growth stands identified by the SLI in the project area, approximately 992 acres of old growth have been field verified.

FIGURE C-12 - CURRENT OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST



*OLD-GROWTH ATTRIBUTES*

The diversity of old-growth definitions and the relative importance of old growth as a specific stand condition led DNRC to develop a tool to analyze and understand old growth. This tool indexes attribute levels in stands using DNRC's SLI and is called the Full Old Growth Index (FOGI).

The old-growth attributes making up FOGI are:

- number of large live trees,
- amount of coarse woody debris,
- number of snags,
- amount of decadence,
- multistoried structures,
- gross volume, and
- crown density.

Old-growth "quality" was raised as an issue. Old-growth quality depends on the type of old growth, associated wildlife species being considered, where old growth exists on the landscape, and other factors that do not lend themselves to consistent or meaningful quantification. For the purposes of this analysis, we are using attribute levels (FOGI) as an indicator of quality, but are also cognizant that quality is too nebulous a concept for a quantitative analysis. Using FOGI provides an indication of the relative levels of "old growthedness". FOGI could be construed as providing an indication of old-growth "quality", but is more appropriately considered an indication of overall attribute levels. So, while the highest attribute levels may be high quality for some wildlife species and old-growth types (for example mixed-conifer old growth, which tends to exist in a dense and structurally diverse condition), other species and types are highest quality at relatively lower attribute levels, in particular the ponderosa pine type (which tends to exist in a more-open condition that is less structurally diverse). Therefore, the analysis focuses on quantitative or qualitative assessment of attribute levels rather than relying on the value-laden concept of "quality".

**Indicators of Old-Growth Attributes**

We recognize that our desired management strategy under the SFLMP is to retain, in reasonable proportions, stands that contain all the naturally occurring combinations of attributes, including those associated with old-growth stands. Thus, in this section, we display current conditions with regard to attributes often associated with old growth. The attributes displayed are numbers of large live trees, amount of coarse woody debris, snags, vigor, stand structure, and gross volume per acre.

Lacking are surveys specifically oriented to clearly identify all stand characteristics that would characterize old growth. However, indices were derived from data in our SLI that summarized the abundance of 4 attributes that often, but not always, characterize stands in the latter stages of development: large live trees, snags, down coarse woody debris, and decadence among live trees. In each case, a standard step-by-step procedure was used that integrated information from more than 1 field in the SLI to produce a single index number (*OLD-GROWTH INDEX ATTRIBUTES AND POINT ASSIGNMENTS* [project file]). Briefly, the "large tree" index measures the relative abundance of trees more than 21 inches dbh. The snag index measures the relative abundance of large dead trees, with greater weight given to larger-diameter snags, but equal weight given to snags by their species and other characteristics. Similarly, the index of down coarse woody debris measures the relative abundance of down woody material, with greater weight given to the logs of larger diameter, regardless

of species or degree of rot. Vigor of old-growth stands is discussed as a surrogate for stand decadence. Stands with higher vigor ratings are those with lower decadence and vice versa.

In each case, only 4 categories of abundance were used, which corresponded roughly to the 4 adjectives:

- none
- few (or little)
- some (i.e., a typical amount for a stand of that forest type and age, neither particularly few nor many)
- many (or much)

This description is necessarily crude; existing conditions or model future effects cannot be described with greater resolution than our current inventory allows. However, our understanding of the naturally occurring abundances and dynamics of these old-growth attributes is similarly crude. Thus, even if a more precise description or assessment were possible, we are unsure the additional resolution would be informative. We believe, moreover, that despite their inevitable approximations, these descriptions and assessments are generally accurate and objective and serve as useful proxies to guide our more general evaluation of diverse forest types and structures.

The FOGI process assigns an index rating to each old-growth attribute that, when summed, indicates its total score, or old-growth index, for the stand. For analysis purposes, these scores can be grouped into low, medium, and high categories. This provides an indication of the condition of the stand in regards to attributes often associated with old growth. These indices do not necessarily indicate old-growth quality, but can be used to compare and classify a collection of older stands across the landscape. The expected variation between covertypes is based on numerous factors, including habitat-type groups, tree species, covertypes, elevations, past management activities, and proximity to roads. Many of these attributes relate to wildlife habitat and are discussed in *APPENDIX F - WILDLIFE ANALYSIS* of this DEIS. *TABLE C-10 - FOGI CLASSIFICATION FOR THE PROJECT AREA AND POSTHARVEST AMOUNTS* shows the current amounts of old-growth acres in each of the FOGI classifications and effects of the action alternatives.

***TABLE C-10 - FOGI CLASSIFICATION FOR THE PROJECT AREA AND POSTHARVEST AMOUNTS***

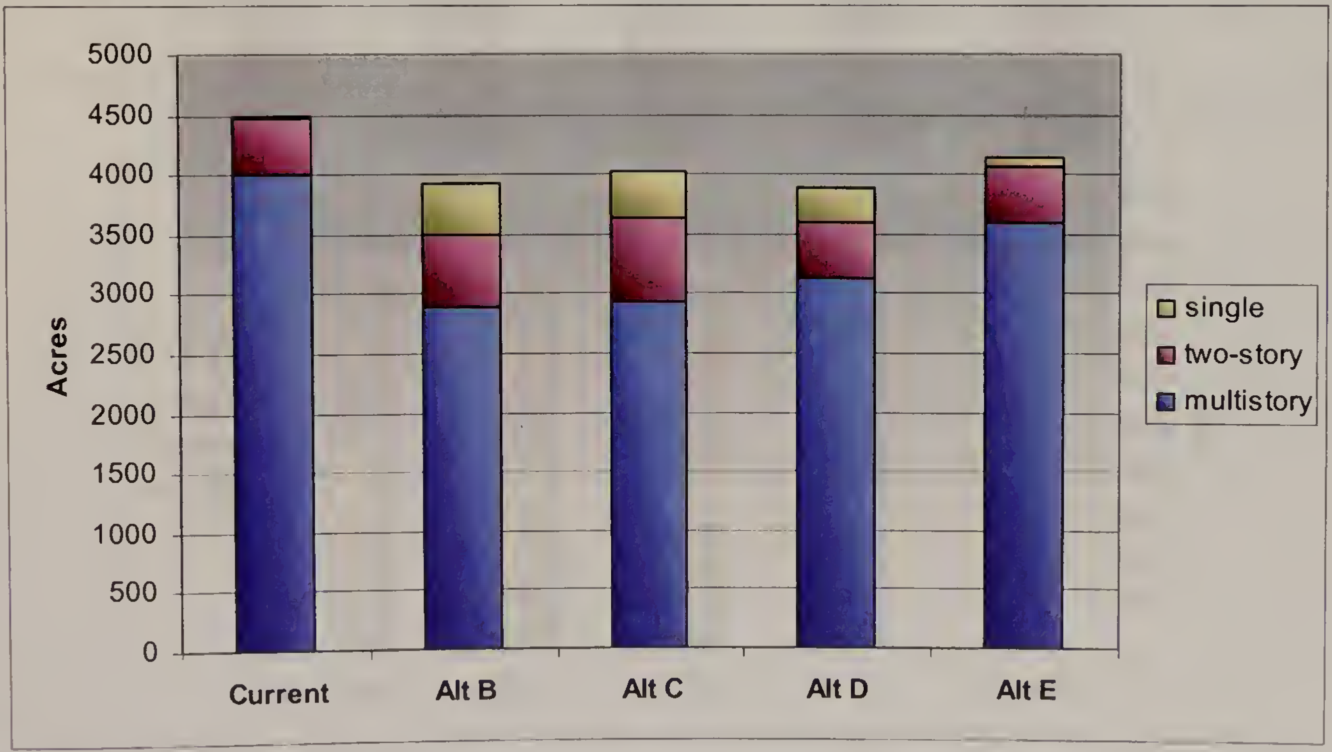
| FOGI CLASSIFICATION | CURRENT ACRES | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|---|
| | | B | C | D | E |
| Low | 68 | 722 | 719 | 615 | 167 |
| Medium | 1,352 | 1,149 | 1,076 | 1,023 | 1,318 |
| High | 3,063 | 2,049 | 2,222 | 2,249 | 2,652 |
| Totals | 4,483 | 3,920 | 4,017 | 3,887 | 4,137 |

### *STAND STRUCTURE OF OLD GROWTH*

The structure of forested stands indicates one characteristic often associated with "old growth", namely whether or not the stand is in a multistoried condition. The multistoried condition arises when a stand has progressed through succession to the point that shade-tolerant species are replacing a shade-intolerant overstory. This condition can also occur when a stand is already dominated by large, old, shade-tolerant species, and through gap replacement the regeneration that occurs is also shade tolerant. The former is the more common case in forests of Montana. In both cases, the time since a major disturbance tends to be long, helping to create many of the attributes important in old growth.

*FIGURE C-13 - CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST* displays the current conditions for stand structure of old growth on Swan River State Forest and the postharvest effects of each action alternative. As shown, the vast majority of old-growth stands have multiple canopy levels. This figure also shows the postharvest distribution of stands for those that would retain old-growth classification. Many of the treatments are regeneration-type harvests, which completely change the stand structures and remove the stands from old-growth classification. Following harvesting activities, there would only be one distinct canopy level. For stands that receive a partial treatment, two or more distinct canopy layers would remain. *FIGURE C-13 - CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST* illustrates the slight changes in structure from multistoried stands to single- or two-storied stands. Also reflected in the figure is the removal of stands that no longer meet the old-growth definition.

***FIGURE C-13 - CURRENT AND POSTHARVEST STRUCTURES BY ALTERNATIVE FOR OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST***



*STAND VIGOR OF OLD GROWTH*

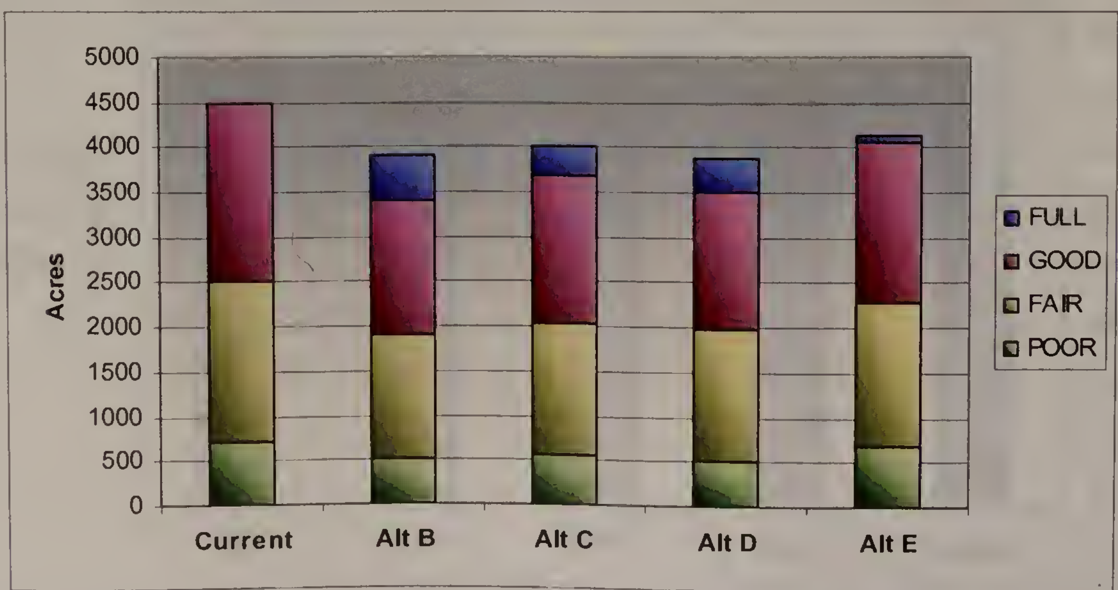
Vigor of old-growth stands is used to indicate relative decadence. Old-growth stands of low vigor are more likely to have more snags and greater amounts of large down woody debris than would be expected with stands of high vigor. Stand vigor is explained further below. *FIGURE C-14 - CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST* shows the vigor classes, by percentage for old-growth stands on Swan River State Forest. As would be expected, no old-growth stands are at full vigor. Most stands are in the fair to poor class.

This figure also illustrates the changes that would take place following harvest prescriptions. The changes are subtle, but stands with full vigor would be increased. The treated stands would have reduced density and a more-open canopy, which would allow more light in and free up nutrients in the soil for the remaining trees to utilize. Stands would shift from the fair or poor vigor to the good or full vigor classification.

The 4 generally recognized vigor classes are: full, good-to-fair, fair-to-poor, and very poor.

- *Vigor 1 - Full Vigor* - Forests have an open canopy and growth is optimal. An example of a stand in this class is young, immature, and probably in the seedling or sapling stage. Currently, no acres of old growth within the project area are at full vigor.
- *Vigor 2 - Good Vigor* - Stand canopies are mostly closed with crown ratios (the vertical height of a tree's crown compared with the total vertical height of the tree) between 33 and 50 percent. Growth rates exceed mortality in these stands. A stand in this class would be young, merchantable sawtimber. Old-growth stands of good vigor represent 1,979 acres in the project area.
- *Vigor 3 - Fair Vigor* - Stand canopies are tightly closed with crown ratios less than 33 percent. Growth and mortality rates are nearly balanced. An example of a stand in this class would be an old stand of merchantable sawtimber. Old-growth stands of fair vigor occupy 1,799 acres in the project area.
- *Vigor 4 - Poor Vigor* - Stands are similar to the fair-to-poor class, but generally are in a decadent condition caused by competing

*FIGURE C-14 - CURRENT AND POSTHARVEST DISTRIBUTION OF VIGOR CLASSIFICATIONS FOR OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST*



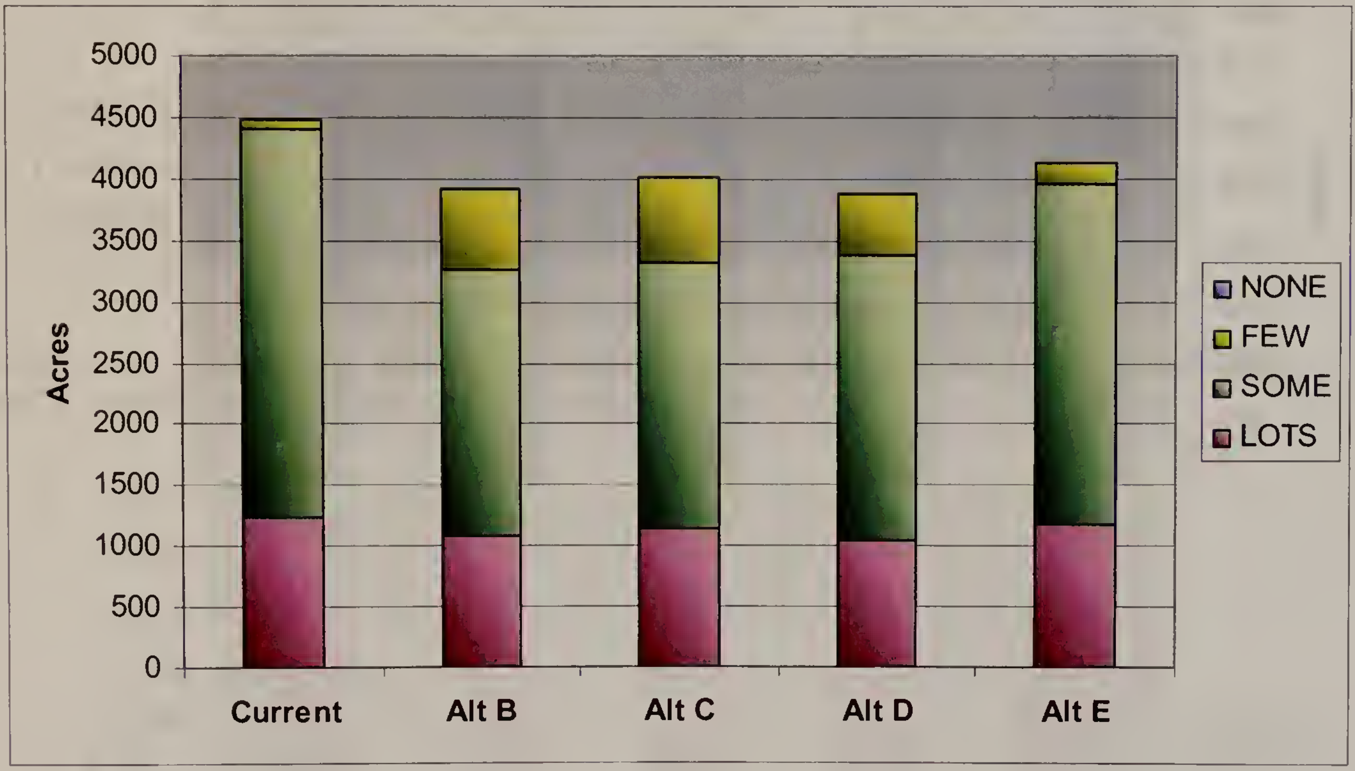
vegetation, insects, diseases, and/or old age. Typically, mortality rates exceed growth rates. Old-growth stands of poor vigor occupy 705 acres in the project area; all are at risk to insects and diseases.

***LARGE TREES PER ACRE***

*FIGURE C-15 - CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST* shows the relative abundance of large trees in old-growth stands on Swan River State Forest. As shown, approximately 28 percent of all old-growth stands are within the highest abundance category for numbers of large live trees, with 71 percent having 'some' the next highest amount.

This figure also shows the subtle changes in the percent of stands with large trees on a per-acre basis. Some stands would no longer meet the old-growth definition and are not included, but for those that are included, the change is very slight. Action Alternative E retains the highest proportions of large trees in the "Some" and "Lots" categories, while the other alternatives show greater reductions in the numbers of large live trees.

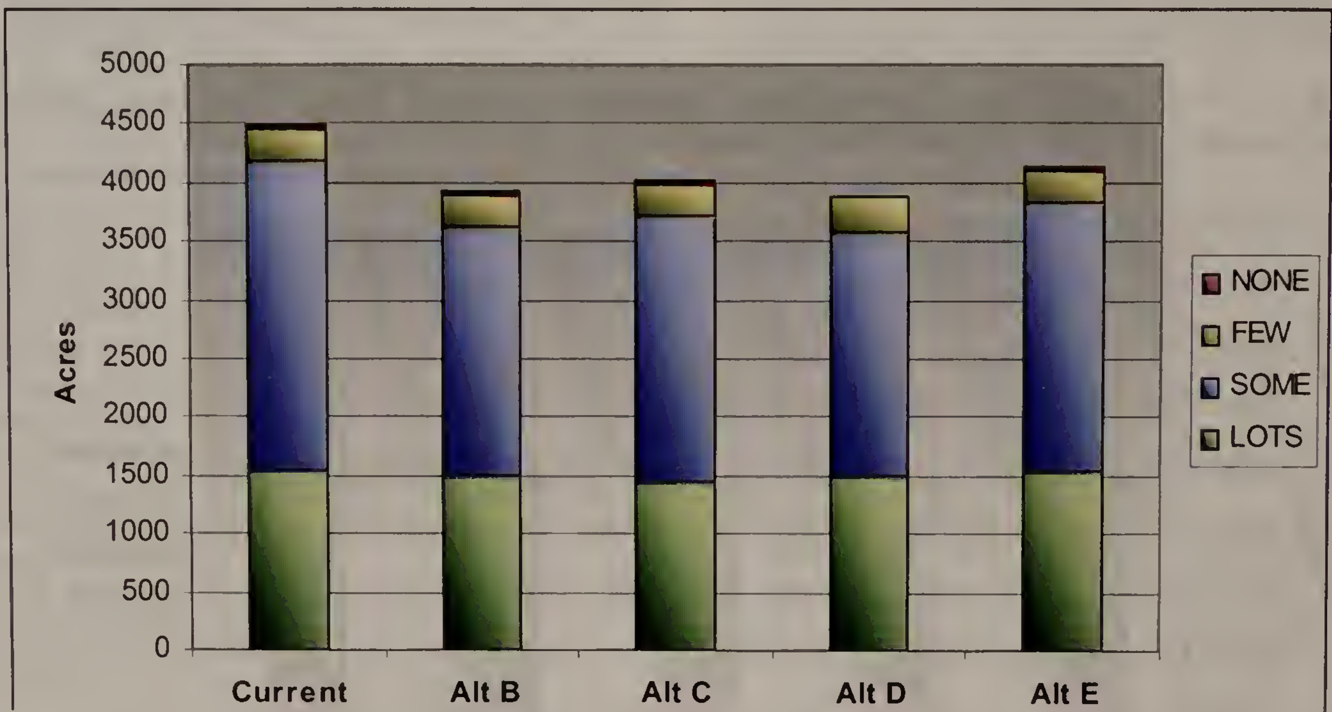
***FIGURE C-15 - CURRENT AND POSTHARVEST AMOUNTS OF LARGE TREES PER ACRE IN OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST***



***SNAGS PER ACRE***

*FIGURE C-16 - CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST* shows the relative abundance of large snags in old-growth stands on Swan River State Forest. The preponderance of stands has some or lots of large snags. The 'few' category represents DNRC's minimum for snag retention postharvest. The amount of snags fluctuates across the landscape due to salvage harvesting, which reduces the numbers and continued mortality from insect and disease activity, which increases snag amounts. This figure also illustrates the postharvest levels of snags per acre. The change in the percentage of stands with the minimum requirements for retention is minor. Over 99 percent of old-growth stands would still have 2 snags or better per acre.

***FIGURE C-16 - CURRENT AND POSTHARVEST AMOUNTS OF SNAGS PER ACRE IN OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST***



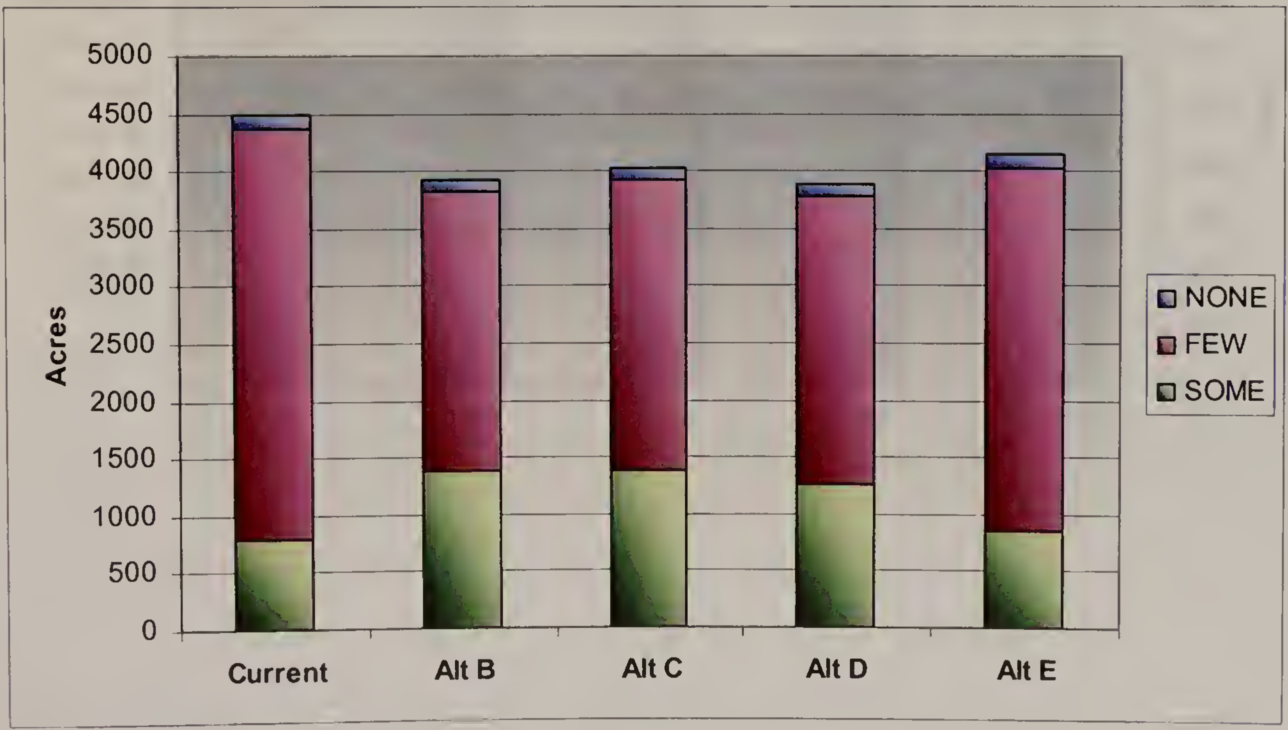
### *AMOUNTS OF COARSE WOODY DEBRIS*

Coarse woody debris is measured by the number of pieces present along transect lines through a stand. The pieces are measured for diameter and grouped in ranges such as 6 to 10, 11 to 15, 16 to 20, and so on. The volume or tons per acre of coarse woody debris is also recorded. The SLI database contains information on coarse woody debris primarily for older stands on Swan River State Forest. The older stands (100+ years) show various quantities and sizes of coarse woody debris. Stands with the most pieces and the greatest tons per acre are between 150 to 200 years old, but are not necessarily old growth. For the project area, the maximum tons per acre are 155, the minimum is 0, and the average for the project area is 42 tons per acre. Stand data information describing number of pieces per grouped range, number of small pieces, number of large pieces, level of decay, and tons per acre is available in the project file.

*FIGURE C-17 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS WITHIN THE PROJECT AREA* shows the relative abundance of down, coarse woody debris in old-growth stands on Swan River State Forest. As with the snag numbers, salvage operations are expected to reduce the amount of coarse woody debris in old-growth stands across Swan River State Forest, resulting in a preponderance of stands in the *some* and *few* categories.

This figure also shows that following harvesting operations, the coarse woody debris remaining would increase, primarily due to slash generated during harvesting. Some stands may not have the finer materials, but the larger-diameter woody debris would be retained.

***FIGURE C-17 - CURRENT AND POSTHARVEST LEVELS OF COARSE WOODY DEBRIS IN OLD-GROWTH STANDS WITHIN THE PROJECT AREA***



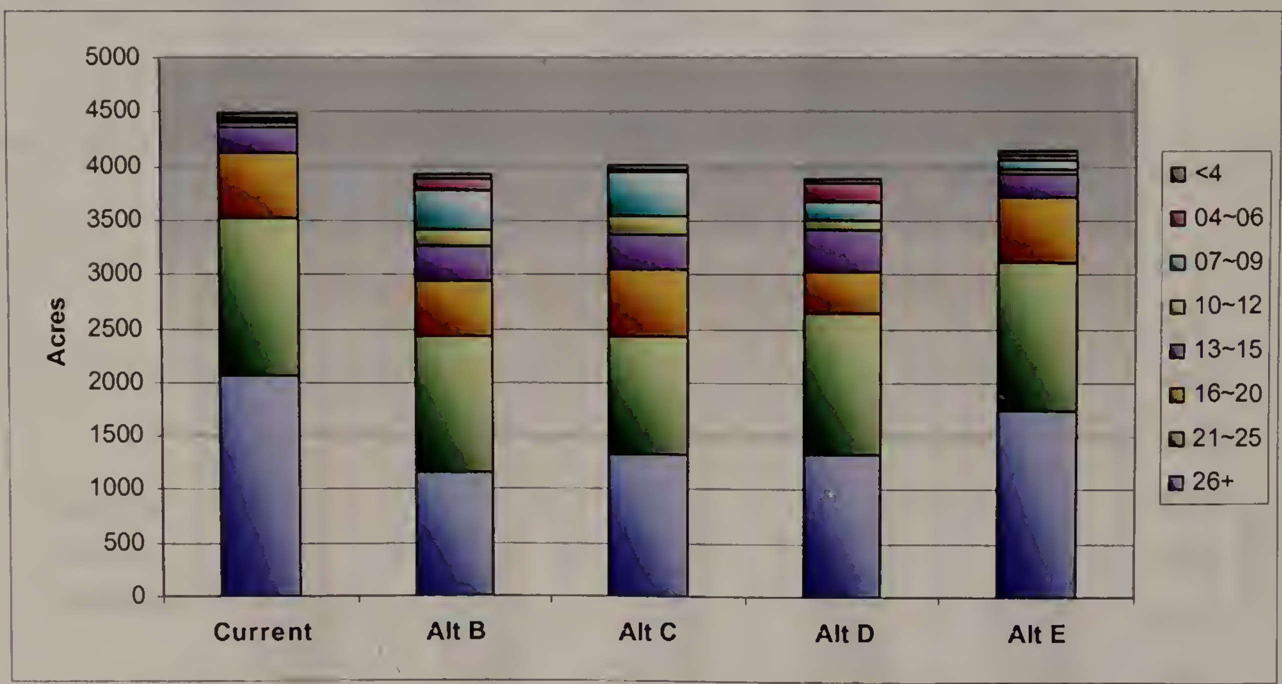
*GROSS VOLUME PER ACRE*

Another attribute of old-growth stands often deemed important and for which distributions can be quantified and effects assessed is a measure of density, or stocking. In this case, the stand's gross board-foot volume per acre is used (*FIGURE C-18 - POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST*). Higher volumes indicate more densely stocked stands. One value of this measure is that effects of in-growth and lack of wildfires are minimized because only trees larger than 9 inches dbh are included. Thus, this becomes another measure through which impacts on the character of old-growth stands can be measured.

As shown, a very small proportion (about 5 percent) of old growth on Swan River State Forest contains less than 10 mbf per acre. Approximately 22 percent of old growth contains over 25 mbf per acre. The majority of the old-growth stands (64 percent) have between 15 and 24 mbf per acre.

*FIGURE C - 18* also illustrates the affects to gross volume per acre following harvesting operations. Old growth with less than 10 mbf per acre would remain around 5 percent. Stands that have 25 mbf per acre and greater would decline slightly to 21 percent of the old-growth stands. The majority of the stands would still have between 15 and 24 mbf per acre, but would decline to 60 percent; the exception would be those harvested under Action Alternative E, where the percentage of stands would remain at 64.

***FIGURE C-18 - POSTHARVEST AMOUNTS OF GROSS VOLUME PER ACRE (MBF) IN OLD-GROWTH STANDS ON SWAN RIVER STATE FOREST***



*PREVIOUS TREATMENTS IN CLASSIFIED OLD GROWTH*

Swan River State Forest has had an ongoing salvage and sanitation program for years. This program has resulted in the reduction of some old-growth attributes in many current old-growth stands through the effects of timber harvesting. The effects of these previous entries include lower attribute levels in the following categories: fewer acres with high numbers of large trees, lower snag numbers, and less coarse woody debris.

*OVERALL EFFECTS TO OLD-GROWTH STANDS*

*TABLE C-11 - OLD-GROWTH FOGI ATTRIBUTE CLASSIFICATION CHANGES PREHARVEST AND POSTHARVEST BY ALTERNATIVE* shows old-growth type and FOGI values for all old-growth stands proposed for treatment in the project area. This table also shows postharvest FOGI values and whether the stands would remain old growth. Seedtree and seedtree-with-reserves treatments would not retain sufficient large live trees postharvest to meet DNRC's old-growth definition, while commercial thinning and shelterwood harvests are expected to meet the definition.

*TABLE C-11 - OLD-GROWTH FOGI ATTRIBUTE CLASSIFICATION CHANGES PREHARVEST AND POSTHARVEST BY ALTERNATIVE*

| CURRENT STAND NUMBER | OLD-GROWTH TYPE | HARVEST PRESCRIPTION | STAND ACRES | PREHARVEST INDEX # | CURRENT FOGI CLASS | EFFECTS BY ACTION ALTERNATIVE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | B | | | C | | | D | | | E | | |
| | | | | | | INDEX # | CLASS | OLD-GROWTH POSTHARVEST | INDEX # | CLASS | OLD-GROWTH POSTHARVEST | INDEX # | CLASS | OLD-GROWTH POSTHAVEST | IINDEX # | CLASS | OLD-GROWTH POSTHARVEST |
| 01-03 | MC | ST | 36 | 28 | High | 8 | Low | No | | | | 8 | Low | No | | | |
| 01-09 | MC | STR | 29 | 21 | High | 10 | Low | No | | | | 10 | Low | Low | | | |
| 03-08 | MC | STR | 143 | 24 | High | 12 | Low | No | | | | 12 | Low | No | | | |
| 03-09 | MC | ST | 12 | 24 | High | | | | | | | | | | 12 | Low | No |
| 03-11 | MC | SW | 31 | 25 | High | | | | 10 | Low | Yes | | | | | | |
| 03-12 | MC | SW | 9 | 27 | High | | | | 10 | Low | Yes | | | | | | |
| 04-15 | MC | CT | 5 | 20 | Medium | 13 | Medium | Yes | 13 | Medium | Yes | | | | | | |
| 04-18 | WL/DF | STR | 60 | 24 | High | 8 | Low | No | 8 | Low | No | 6 | Low | No | 6 | Low | No |
| 04-19 | MC | ST | 13 | 22 | High | 8 | Low | No | 8 | Low | No | | | | | | |
| 04-20 | MC | SW | 110 | 25 | High | | | | 10 | Low | Yes | | | | | | |
| 04-22 | PP | CT | 24 | 21 | High | | | | 12 | Low | Yes | 12 | Low | Yes | | | |
| 09-07 | MC | SW | 80 | 22 | High | 10 | Low | Yes | 10 | Low | Yes | 10 | Low | Yes | 10 | Low | Yes |
| 09-10 | DF | ST | 8 | 13 | High | 8 | Low | No | 68 | Low | No | | | | | | |
| 09-12 | WWP | CT | 19 | 22 | High | 12 | Low | Yes | 12 | Low | Yes | 12 | Low | Yes | 12 | Low | Yes |
| 09-13 | WL/DF | STR | 53 | 18 | Medium | | | | | | | 11 | Low | No | | | |
| 09-15 | WWP | CT | 108 | 16 | Medium | 12 | Low | Yes | 12 | Low | Yes | | | | | | |
| 09-18 | WL/DF | ST | 34 | 15 | Medium | 8 | Low | No | 8 | Low | No | 8 | Low | No | 8 | Low | No |
| 10-06 | MC | CT | 85 | 20 | Medium | | | | | | | 12 | Low | Yes | | | |
| 10-10 | MC | SW | 74 | 18 | Medium | | | | | | | 8 | Low | Yes | | | |
| 14-13 | WWP | CT | 36 | 21 | High | | | | | | | 12 | Low | Yes | | | |
| 14-14 | MC | SW | 83 | 20 | Medium | | | | | | | 8 | Low | Yes | | | |
| 15-17 | MC | SW | 61 | 20 | Medium | 12 | Low | Yes | | | | | | | | | |
| 16-24 | MC | ST | 43 | 22 | High | 8 | Low | No | 8 | Low | No | 8 | Low | No | 8 | Low | No |
| 22-10A | MC | STR | 53 | 21 | High | 8 | Low | No | 8 | Low | No | 8 | Low | No | 8 | Low | No |
| 22-10B | MC | SW | 55 | 21 | High | 12 | Low | Yes | 12 | Low | Yes | 12 | Low | Yes | | | |
| 22-10C | MC | CT | 91 | 21 | High | 12 | Low | Yes | 12 | Low | Yes | 12 | Low | Yes | | | |
| 22-11 | MC | STR | 59 | 21 | High | 8 | Low | No | 8 | Low | No | 8 | Low | No | 8 | Low | No |
| 25-12 | MC | SW | 81 | 22 | High | 12 | Low | Yes | | | | | | | | | |
| 25-13 | MC | SW | 58 | 22 | High | 12 | Low | Yes | | | | | | | | | |
| 26-02 | MC | SW | 134 | 20 | Medium | | | | 12 | Low | Yes | | | | | | |
| 27-11A | MC | SW | 84 | 21 | High | 12 | Low | Yes | 12 | Low | Yes | | | | | | |
| 27-11B | MC | CT | 16 | 21 | High | 12 | Low | Yes | 12 | Low | Yes | | | | | | |
| 27-19 | WL/DF | STR | 86 | 22 | High | 8 | Low | No | 8 | Low | No | 8 | Low | No | 8 | Low | No |

## ALTERNATIVE EFFECTS TO OLD GROWTH

### Direct Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Old Growth***

  In the short term, existing old-growth stands would continue to experience substantial mortality of large Douglas-fir trees, increasing the snag and down-woody-debris components of those stands. Some stands may no longer be in the old-growth classification as a result of the gradual or sudden loss of many large trees due to Douglas-fir bark beetles, mountain pine beetles, dwarf mistletoe, drought, competition, etc. These factors can reduce the number of large, live trees below the minimum described in *Green et al. (1992)*. Over the long term, existing old growth would continue to age and become more decadent.

- ***Direct Effects of Action Alternatives B, C, D, and E to Old Growth***

  The proposed harvest treatments for all of the action alternatives would affect old growth, as illustrated in *TABLE C-12 - AREA OF OLD GROWTH PROPOSED FOR HARVESTING BY COVERTYPE.*

Old-growth stands would be harvested with seedtree, seedtree-with-reserves, shelterwood, and commercial-thin treatments. The main objectives for entering these old-growth stands are to remove insect-infested and disease-infected trees, maintain historical covertypes, and remove or reduce shade-tolerant species. Some commercial thinning and shelterwood units may be classified as old growth following harvesting; postharvest data collection in the particular stands would determine their classification.

The primary effects to old growth would be the removal of stands from their old-growth classification or a reduction of attribute levels associated with old-growth stands. The old-growth attributes that would be affected include:

- Stocking levels in all treated stands would be reduced. The stocking levels in the

***TABLE C-12 - AREA OF OLD GROWTH PROPOSED FOR HARVESTING BY COVERTYPE***

| | | | MIXED CONIFER | WESTERN LARCH/ DOUGLAS-FIR | WESTERN WHITE PINE | PONDEROSA PINE | DOUGLAS-FIR | SUBALPINE FIR | TOTALS |
|---|---|---|---|---|---|---|---|---|---|
| Current conditions in project area | | | 3,359 | 418 | 346 | 24 | 8 | 328 | 4,483 |
| ACTION ALTERNATIVE | B | Proposed for harvest | 967 | 120 | 126 | 0 | 8 | 0 | 1,221 |
| | | Postharvest | 2,592 | 630 | 346 | 24 | 0 | 328 | 3,920 |
| | C | Proposed for harvest | 844 | 120 | 126 | 24 | 8 | 0 | 1,122 |
| | | Postharvest | 2,770 | 549 | 346 | 24 | 0 | 328 | 4,017 |
| | D | Proposed for harvest | 891 | 173 | 55 | 24 | 0 | 0 | 1,143 |
| | | Postharvest | 2,633 | 548 | 346 | 24 | 8 | 328 | 3,887 |
| | E | Proposed for harvest | 307 | 120 | 19 | 0 | 0 | 0 | 446 |
| | | Postharvest | 3,133 | 298 | 346 | 24 | 8 | 328 | 4,137 |

commercial-thin units would be approximately half the current levels. Shelterwood units would be reduced to approximately 20 percent of current stocking levels. The stocking levels for seedtree and seedtree-with-reserves units would be approximately 10 percent of current levels (the stands would not be old growth postharvest).

- Stand vigor would improve or remain at existing levels for harvested stands.

- Stand structure in seedtree, seedtree-with-reserves, and shelterwood units would be reduced to single- or two-storied stand structures following harvesting. Commercial-thin units would be reduced to 2- and 3-storied (multi) stand structures following harvesting.

- Minimum snag retention per acre for all units would consist of 2 trees, 21-inches dbh or greater; if no trees that large are present, the next largest trees would be retained. In addition, 2 snag-recruit trees per acre, 21-inches dbh or greater, would be retained.

- Slash would be piled and burned or otherwise treated on site; approximately 15 tons of coarse woody debris per acre would be retained. Seedtree or seedtree-with-reserve units may, where feasible, have broadcast-burn treatments applied.

- Large, live trees would be removed if they are dying from insect or disease attacks or to provide openings for regeneration. Seedtree and seedtree-with-reserve units would retain 6 to 8 trees per acre, with emphasis given to larger diameter trees. Health, vigor, cone production, and other factors would be considered when selecting trees for retention purposes. Shelterwood units would have a retention level of 12 to 16 trees per acre, with the same selection criteria as used on seedtree units. Commercial-thin units would retain 90 to 100 trees per acre, or 40- to 50-percent canopy cover, with priority given to the healthier, better-formed individuals in the stand.

**Indirect Effects**

- ***Indirect Effects of No-Action Alternative A to Old Growth***

  Not harvesting in old-growth stands would continue the existing risk of stand-replacement-type fires that would likely consume portions of the old-growth stands in their paths.

  Existing open roads would continue to provide access to firewood gatherers, reducing the development of snags and coarse woody debris on those sites.

  Over time and barring large scale disturbances, old-growth attribute levels would increase on most covertypes as climax species mature, decadence increases, and trees die and fall, creating more snags and large woody debris. However, the large-tree component is likely to be reduced over time as large shade-intolerant species die and are replaced by smaller shade-tolerant species with a lesser chance of becoming large.

  These same stands would also reach a point where the old-growth attribute levels decrease. As large trees continue to age and eventually die, some stands would no longer meet the old-growth definition.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Old Growth***

All action alternatives would harvest timber in or near old-growth stands and create more abrupt stand edges. Some mature stands not yet classified as old growth could be considered old growth in the future. Commercial-thin harvesting within these mature stands would increase the diameter growth rates of remaining trees and, in some cases, may hasten the development of old-growth attributes, especially large diameter trees.

**Cumulative Effects**

- ***Cumulative Effects to Old Growth Common to All Alternatives***

Swan River State Forest's salvage program has completed limited harvesting in old growth on the High Blow '02 Salvage and the Big Blowdown Salvage timber sales. Currently, the Cilly Bug and Rock Squeezer timber sales are harvesting in designated old-growth stands. Red Ridge would propose to do some harvesting in old-growth stands.

It should be noted that timber stands, whether harvesting occurs or not, may be reinventoried or reindexed in regard to adjustments of stand boundaries; a more intensive inventory may change the old-growth status.

Past road construction, timber harvests, wildfires, and general site characteristics have led to the current amount of old-growth characteristics in the entire area. The salvage harvesting would not alter old-growth designation, but would reduce numbers of large snags and coarse woody debris and potentially decrease stand decadence. Future timber sales and thinning projects would likely continue to take place in the analysis area. If additional management projects were proposed, the MEPA process would be implemented.

Action Alternative B would harvest approximately 1,221 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 12.6 percent. Following harvesting operations, 564 acres would no longer meet old-growth criteria, while 658 acres would retain the old-growth classification. The amount of old growth remaining on Swan River State Forest would be 11,914 acres, and the proportion of acreage classified as old growth would be 30.9 percent.

Action Alternative C would harvest approximately 1,122 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 10.4 percent. Following harvesting operations, 466 acres would no longer meet old-growth criteria, while 656 acres would retain old-growth classification. The amount of old-growth acres remaining on Swan River State Forest would be 12,012 acres, and the proportion of acreage classified as old growth would be 31.2 percent.

Action Alternative D would harvest approximately 1,143 acres of old growth in the project area, which would reduce the amount of old-growth acres in the project area by 13.3 percent. Following harvesting operations, 596 acres would no longer meet old-growth criteria, while 547 acres would retain old-growth classification. The amount of old growth remaining on Swan River State Forest would be 11,854 acres, and the proportion of acreage classified as old growth would be 30.8 percent.

Action Alternative E would harvest approximately 446 acres of old growth in the project area, which would reduce the amount of old-

growth acres in the project area by 7.7 percent. Following harvesting operations, 347 acres would no longer meet old-growth criteria, while 99 acres would retain old-growth classification. Swan River State Forest would contain 12,131 acres of old growth; the proportion of acreage classified as old growth would be 31.5 percent.

Recognizing that the amounts and distributions of all age classes would shift and change over time, the amount of old growth remaining is within an expected range of natural variation.

### *AGE AND COVERTYPE PATCH*

#### Age Patches

Traditionally, forest management has focused on forest stands, which are typically defined as units with similar characteristics of tree species, tree sizes, and stocking levels. However, some understanding of the environment can be gained by examining different groupings of stands according to fewer characteristics such as age class or covertype. For example, the size of patches of equivalent age is one way to assess effects of management activities to the forested landscape. Age-class patches broadly reflect disturbance in the natural environment and the additional influence of harvesting and associated activities in the managed environment.

Forests change over time. Tracking the changes from historical to current conditions can indicate the effects of management and whether the direction of change is desirable. Assessing historic forest conditions is fraught with challenges, such as a lack of actual data or, even when data is available, compatibility with current information. DNRC has maps of an inventory conducted in the 1930s that provide a general baseline for age (and covertype) patches for Swan River State Forest and the project area. The data does not provide for a seamless comparison between historic and current conditions due to differences in mapping procedures, primarily an eight-fold difference in minimum map-unit size (40 acres historically and 5 acres currently). The reduced minimum-map unit size results in many more patches of a smaller average size, even when applied to the same forest at the same point in time. However, the data does represent the best historic information available; therefore, the data is presented with the caveats mentioned in this paragraph.

This analysis focuses on stand age classes. The oldest age class also encompasses all old-growth stands. However, old growth would represent only a portion of all old-age stands, as not all old stands would meet the large tree requirements that are part of DNRC's old-growth definitions. Reconstructing the historic data to quantify patch characteristics of old growth is not possible, and, so, comparisons between historic and current conditions are not made. An analysis of the current patch characteristics of old growth and the effects of each action alternative is presented below (see *OLD-GROWTH PATCHES*).

Historic data indicates that old-stand patches were very large in both Swan River State Forest and the project area, with the patches being much larger in the project area than for the entire Swan River State Forest (*TABLE C-13 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR SWAN RIVER STATE FOREST, IN ACRES* and *TABLE C-14 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR THE PROJECT AREA, IN ACRES*). Historically, a single large old-stand patch, exceeding 14,000 acres, dominated Swan River State Forest and the project area (previous DNRC analysis indicates that large stands would be divided

*TABLE C-13 - HISTORIC AND CURRENT MEAN PATCH SIZES BY AGE CLASS FOR SWAN RIVER STATE FOREST, IN ACRES*

| AGE CLASS | HISTORIC | CURRENT |
|---|---|---|
| None | 120.9 | 20.4 |
| 0 to 39 years | 91.0 | 35.1 |
| 40 to 99 years | 134.5 | 60.1 |
| 100-year-old stand | 76.4 | 51.1 |
| Old stand | 664.8 | 183.1 |
| Overall | 280.0 | 64.3 |

into many additional polygons using today's mapping protocols, even in the absence of any harvest-related activities). Other age patches were variable in size between the project level and Swan River State Forest. The expectation is that the project area would naturally have smaller patch-size means due to imposing the artificial project area boundary onto some existing patches. On average, current age-class patches are much smaller than historically. Some of the decrease can be attributed to different map-unit minimums, but the data likely reflects a real reduction in mean patch sizes, as harvesting and roads have broken up some previously intact patches.

Current old-stand patches are much smaller at the scale of Swan River State Forest than they were historically. Project area old-stand patches are larger than the historic mean for Swan River State Forest, but are approximately one-third the size of historic patches in the project area. At the scales of both the project area and Swan River State Forest, all other age patches are smaller currently than historically.

**Alternative Effects**

***Direct and Indirect Effects***

- ***Direct and Indirect Effects of No-Action Alternative A on Patch Size***

  Patch sizes would not be immediately affected. Over time, the forest would tend to homogenize, leading to larger patches of older stands, especially in the absence of significant fires or other disturbance events.

- ***Direct and Indirect Effects of All Action Alternatives on Patch Size***

  Within the project area, the mean old-stand patch size would be reduced to about one half of current means with all action alternatives. Action Alternative B would reduce old-stand patch size the most, with the other action alternatives being roughly equivalent (*TABLE C-14 - POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR ACTION ALTERNATIVES B, C, D, AND E, IN ACRES*). Other

*TABLE C-14 - PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY AGE CLASS FOR ACTION ALTERNATIVES B, C, D, AND E, IN ACRES*

| AGE CLASS | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|
| | B | C | D | E |
| None | 19.5 | 19.5 | 19.5 | 19.5 |
| 0 to 039 years | 102.2 | 103.6 | 88.4 | 85.5 |
| 40 to 099 years | 65.1 | 65.1 | 65.2 | 68.0 |
| 100-year-old stand | 65.2 | 62.7 | 52.6 | 48.5 |
| Old stand | 360.8 | 397.6 | 402.1 | 393.2 |
| Overall | 112.4 | 113.6 | 104.6 | 106.7 |

age patches would be only marginally affected, except the 0-to-39-year-old class, where mean patches would be increased with each action alternative, reflecting the effort to group stand-replacement harvesting near other previously harvested areas. Although the patch size of the youngest age class would be increased with each action alternative, the overall mean age-class patch would remain considerably smaller than the historic mean.

Compared to current conditions, project-level effects indicate that Action Alternatives B, C, and E would slightly increase the mean size of age patches, while Action Alternative D would slightly decrease the mean. This would occur despite large decreases in mean patch size of the oldest age class with each action alternative.

*Cumulative Effects*

- ***Cumulative Effects of All Alternatives on Patch Size***

The current age-class patch condition reflects the effects of natural disturbances and succession and the cumulative effects of previous activities by DNRC that have been completed and mapped. Overall, age patches for the entire forest and the project area are reduced from historic to current conditions. Other ongoing projects that have not been mapped to date would have a slight effect of decreasing patch sizes at the scale of Swan River State Forest through conversion of approximately 360 acres of various age classes to the 0-to-39-year age class through regeneration harvesting. Within the project area, cumulative effects of other harvests have been incorporated.

*OLD-GROWTH PATCHES*

Old growth represents a subset of the old-stand age class. Old stands must contain a specified number and size of 'large' live trees to meet the old-growth definition; those large trees must also meet or exceed minimum age requirements. This analysis displays current patch-size characteristics of old growth and the effects of each alternative. This analysis does not present a corresponding analysis of historical old-growth patch characteristics because the data does not exist. Although it cannot be verified with observations of historic old-growth patch size, the reductions in patch size of old-age stands is expected to reflect a similar reduction in patch size of old-growth stands, but the absolute magnitude is unknown.

Currently, the mean patch size of old-growth stands on Swan River State Forest is 123.5 acres (*TABLE C-15 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND WITHIN THE PROJECT AREA, IN ACRES*). Within the project area, the mean old-growth patch size is 344.9 acres. Old-growth patches are about one-third to one-half the mean size of old-stand patches. The disparity between patch sizes of old stands and old growth reflects the addition of the large tree number, size, and age requirements.

*TABLE C-15 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND WITHIN THE PROJECT AREA, IN ACRES*

| SWAN RIVER STATE FOREST | PROJECT AREA | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|---|
| | | B | C | D | E |
| 123.5 | 344.9 | 165.5 | 156.3 | 155.3 | 212.3 |

Alternative Effects

*Direct and Indirect Effects*

- ***Direct and Indirect Effects of No-Action Alternative A on Old-Growth Patches***

  The patch size of old-growth stands would not be immediately affected. Over time, the effects to old-growth patch size would be uncertain because it would depend on the development of large live trees within old-age stands and because current insect and disease infestations are killing many large trees, causing the stands to fall out of the old-growth classification. If existing large live trees remain alive and new large trees develop in old-age stands, the mean patch size of old growth would be expected to increase. Conversely, if existing large live trees continue to die and new ones fail to develop because of overly dense stands, the mean patch size of old growth would be expected to decrease.

- ***Direct and Indirect Effects of All Action Alternatives on Old-Growth Patches***

  Each action alternative would reduce the mean patch size of old growth within the project area (*TABLE C-15 - CURRENT AND POSTHARVEST MEAN PATCH SIZES OF OLD GROWTH ON SWAN RIVER STATE FOREST AND WITHIN THE PROJECT AREA, IN ACRES*). Action Alternative D would reduce the mean patch size of old growth the most (by 189.6 acres), while Action Alternative E would reduce it the least (by 132.6 acres). At the scale of Swan River State Forest, old-growth patch sizes would be reduced with each action alternative. Action Alternative D would result in the largest decrease (19.4 acres), while Action Alternative E would result in the smallest decrease (11.1 acres), with the other alternatives intermediate in their decrease.

*Cumulative Effects*

- ***Cumulative Effects of All Alternatives on Old-Growth Patches***

  The current old-growth-patch condition reflects the effects of natural disturbance and succession and the cumulative effects of previous activities by DNRC that have been completed and mapped. Overall, old-growth patches for the entire forest and the project area are likely reduced from historic to current conditions. Other ongoing projects have not entered old-growth stands. Within the project area, cumulative effects of other harvests have been incorporated in the *Effects Analysis*.

*COVERTYPE PATCHES*

Historic data suggests mean covertype patch sizes are similar to age patch sizes, in part, due to the single large patch of old western larch/Douglas-fir that dominated the forest and project area. As with mean age-class patch sizes, the differences in mapping protocols and, in particular, a different minimum map-unit size confound direct comparison and drawing clear conclusions. However, a real decrease in mean covertype patch size is expected due to the effects of harvesting and road building. The effects of succession confound the results and are reflected in the increased patch size of shade-tolerant types (mixed-conifer and subalpine types).

Overall, current covertype patches on Swan River State Forest and the project area are about one-third the size of the historic mean (*TABLE C-16 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR SWAN RIVER STATE FOREST, IN ACRES* and *TABLE C-17 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR THE PROJECT AREA, IN ACRES*). Currently, the project area covertype patches tend to be larger than for Swan River State Forest.

*TABLE C-16 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR SWAN RIVER STATE FOREST, IN ACRES*

| COVERTYPE CLASS | HISTORIC | CURRENT |
|---|---|---|
| Douglas-fir | - | 28.0 |
| Hardwood | 28.5 | 19.7 |
| Lodgepole pine | 94.9 | 38.2 |
| Mixed conifer | 119.3 | 168.8 |
| Noncommercial | 85.2 | - |
| Nonforest | 32.9 | 18.0 |
| Nonstocked | - | 17.6 |
| Ponderosa pine | 127.3 | 42.9 |
| Subalpine | 170.9 | 232.6 |
| Water | 25.6 | 21.9 |
| Western larch/ Douglas-fir | 792.8 | 64.7 |
| Western white pine | 157.9 | 75.0 |
| Overall | 223.4 | 73.4 |

*TABLE C-17 - HISTORIC AND CURRENT MEAN PATCH SIZES BY COVERTYPE FOR THE PROJECT AREA, IN ACRES*

| COVERTYPE CLASS | HISTORIC | CURRENT |
|---|---|---|
| Douglas-fir | - | 11.8 |
| Lodgepole pine | 107.2 | 49.9 |
| Mixed conifer | 455.3 | 528.5 |
| Noncommercial | 84.9 | - |
| Nonforest | 29.3 | 19.5 |
| Nonstocked | - | 41.6 |
| Ponderosa pine | 79.4 | 22.8 |
| Subalpine fir | 186.3 | 428.8 |
| Western larch/ Douglas-fir | 3,110.3 | 87.7 |
| Western white pine | 634.5 | 81.4 |
| Overall | 440.3 | 144.8 |

## Alternative Effects to Patches

### *Direct and Indirect Effects*

- ***Direct and Indirect Effects of No-Action Alternative A on Covertype Patches***

  The covertype patch sizes would not be immediately affected; however, over time, diversity of habitats in terms of covertype patches would likely be reduced through forest succession. The result would be an increase in mean size of patches dominated by shade-tolerant species as shade-intolerant species are excluded.

- ***Direct and Indirect Effects of All Action Alternatives on Covertype Patches***

  Each action alternative would slightly reduce the average covertype patch size (*TABLE C-18 - POSTHARVEST MEAN PATCH SIZES BY COVERTYPE FOR EACH ALTERNATIVE, IN ACRES*). Action Alternative D would reduce the mean patch size the most, Action Alternative E the least. The greatest changes in cover patch sizes would occur within two types, the mixed-conifer and the western larch/ Douglas-fir patches. The mixed-conifer patches would be reduced in size with each alternative, Action Alternative B the most and Action Alternative E the least. The western larch/Douglas-fir patches would be increased in size with each alternative, Action Alternative C the most and Action Alternative D the least. Other covertype patch sizes would only be affected marginally or not at all by the project.

*TABLE C-18 - PROJECT AREA POSTHARVEST MEAN PATCH SIZES BY COVERTYPE FOR EACH ALTERNATIVE, IN ACRES*

| COVERTYPE CLASS | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|
| | B | C | D | E |
| Douglas-fir | 10.2 | 10.2 | 11.8 | 11.8 |
| Lodgepole pine | 49.9 | 49.9 | 49.9 | 49.9 |
| Mixed conifer | 212.7 | 224.8 | 259.0 | 309.4 |
| Nonforested | 19.5 | 19.5 | 19.5 | 19.5 |
| Nonstocked | 41.6 | 41.6 | 41.6 | 41.6 |
| Ponderosa pine | 22.8 | 16.1 | 16.1 | 22.8 |
| Subalpine fir | 428.8 | 428.8 | 428.8 | 428.8 |
| Western larch/Douglas-fir | 140.1 | 150.0 | 99.6 | 113.1 |
| Western white pine | 97.4 | 86.7 | 116.5 | 71.7 |
| Overall | 130.5 | 130.5 | 125.8 | 132.1 |

*Cumulative Effects*

- ***Cumulative Effects of All Alternatives on Covertype Patches***

  The current covertype patch condition reflects previous activities by DNRC and natural disturbances and succession that have been completed and mapped. Overall, covertype patch sizes have been reduced from historic to current conditions. Other ongoing projects that have not been mapped to date would have a slight effect of decreasing patch sizes at the scale of Swan River State Forest. Within the project area, cumulative effects of other harvests have been incorporated.

## SENSITIVE PLANTS

*ANALYSIS METHODS*

The Montana Natural Heritage Program (http://www.nhp.nris.mt.gov) database was searched in May 2003 for plant species and the habitat that would support these plants in the vicinity of Swan River State Forest. Botanists were contracted to perform a site-specific survey for sensitive plants within the project area. Results of this search were compared to the location of proposed harvest sites for potential direct and indirect impacts and the need for mitigation measures.

The majority of sensitive plants and their related habitat features were found in wet meadows, areas that are not normally classified as forest stands or considered for timber harvesting. The survey identified 9 species of special concern, existing within a total of 19 separate populations (*Pierce and Barton 2003*); none of these plant populations are within the project area.

*ALTERNATIVE EFFECTS TO SENSITIVE PLANTS*

No effects are expected because no populations of sensitive plants occur within the project area.

**Cumulative Effects**

- ***Cumulative Effects of All Action Alternatives to Sensitive Plants***

  If changes occur in the water yield or nutrient level, sensitive plant populations may, in turn, be affected. Given the level of the proposed and active harvesting on Swan River State Forest and other land in the project area, no measurable changes in water yield or surface water levels are anticipated from any of the proposed action alternatives in South Fork Lost or Soup creeks. No measurable changes in water yield or surface water levels are anticipated from Action Alternatives B or C in Cilly

Creek. Water yield and surface water levels could increase slightly from Action Alternatives D and E in Cilly Creek. No change in nutrient levels would occur due to mitigation measures designed to prevent erosion and sediment delivery.

## NOXIOUS WEEDS

### *INTRODUCTION*

Spotted knapweed (*Centaurea mauclosa* Lam.), orange hawkweed (*Hieracium aurantiacum*), and common St. Johnswort (*Hypericum perforatum* L.) have become established along road edges within the project area. Swan River State Forest has begun a program to reduce the spread and occurrence of noxious weeds.

### *ALTERNATIVE EFFECTS*

#### Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Noxious Weeds***

  Noxious weed populations would continue as they exist. Weed seed would continue to be introduced by recreational use of the forest and log hauling and logging activities on adjacent ownerships. Swan River State Forest may initiate spot spraying to reduce noxious weed spread along roads under the FI program.

- ***Direct and Indirect Effects of All Action Alternatives to Noxious Weeds***

  Logging disturbance would provide opportunities for increased establishment of noxious weeds; log hauling and equipment movement would introduce seeds from other sites. Occurrence and spread of existing or new noxious weeds would be reduced by mitigation measures in the form of integrated weed-management techniques. Grass seeding of new and disturbed roads and landings and spot spraying of new infestations would reduce or prevent the establishment of new weed populations. Requiring contractors to wash and inspect machinery prior to entering the project area would reduce the introduction of noxious weed seeds. Roadside herbicide spraying would reduce existing populations of noxious weeds. All herbicide applications would follow label directions, avoid introduction of chemicals into riparian systems, and target only the intended species of noxious weeds.

#### Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Noxious Weeds***

  Salvage logging on State land and logging activities on adjacent lands would continue to provide opportunities for noxious weeds to become established. Current population levels would continue to exist and may increase over time.

- ***Cumulative Effects of All Action Alternatives to Noxious Weeds***

  The action alternatives, together with other management and recreational activities on Swan River State Forest, would provide an opportunity for the transfer of weed seed and increased establishment of noxious weeds. Preventative actions facilitated by the Lake County Weed Board and active weed-management activities performed by Swan River State Forest would reduce the spread and establishment of noxious weeds, as well as the impacts resulting from the replacement of native species. Swan River State Forest would continue to perform weed management through this action depending on funding levels.

Appendix D

Watershed and Hydrology Analysis

# APPENDIX D
# WATERSHED AND HYDROLOGY ANALYSIS

## INTRODUCTION

The issue was raised that timber harvesting and associated activities may cause sediment delivery to streams and may increase water yield.

### ➢ *SEDIMENT DELIVERY*

Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams. Construction of roads, skid trails, and landings can generate and transfer substantial amounts of sediment through the removal of vegetation and exposure of bare soil. In addition, removal of vegetation near stream channels reduces the sediment-filtering capacity and may reduce channel stability and the amounts of large woody material. Large woody debris is a very important component of stream dynamics, creating natural sediment traps and energy dissipaters to reduce the velocity and erosiveness of stream flows.

### ➢ *WATER YIELD*

Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Water yields increase proportionately to the percentage of canopy removal, because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which lead to further increases in water yield. Higher water yields may lead to increases in peak flows and peak-flow duration, which can result in accelerated streambank erosion and sediment deposition.

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## ANALYSIS METHODS

### ➢ *SEDIMENT DELIVERY*

Methodology for analyzing sediment delivery was completed using a sediment-source inventory. All roads and stream crossings were evaluated to determine sources of introduced sediment. In addition, in-channel sources of sediment were identified using channel-stability rating methods developed by *Pfankuch (1975)* and through the conversion of stability rating to reach condition by stream type developed by *Rosgen (1996)*. These analyses were conducted in 1999 by a contracted firm and verified by a DNRC hydrologist. In addition, data were collected in 2003 to quantify sediment delivery using procedures adapted from the *Washington Forest Practices Board (Callahan, 2000)*.

### ➢ *WATER YIELD*

The water-yield increase for the watershed in the project area was determined using the Equivalent Clearcut Area (ECA) method as outlined in *Forest Hydrology Part II (Haupt, 1976)*. ECA is a function of total area roaded and harvested, percent of crown removal in harvesting, and amount of vegetative recovery that has occurred in harvest areas. This method equates area harvested and percent of crown removed with an equivalent amount of clearcut

area. For example, if 100 acres had 60 percent crown removed, ECA would be approximately 60, or equivalent to a 60-acre clearcut. The relationship between crown removal and ECA is not a 1-to-1 ratio, so the percent ECA is not always the same as the percent canopy removal. As live trees are removed, the water they would have evaporated and transpired either saturates the soil, or is translated to runoff. This method also calculates the recovery of these increases as new trees vegetate the site and move toward preharvest water use.

In order to evaluate the watershed risk of potential water-yield increase effectively, a threshold of concern must be established. In order to determine a threshold of concern, acceptable risk level, resource value, and watershed sensitivity are evaluated according to *Young (1989)*. The watershed sensitivity is evaluated using qualitative assessments, as well as procedures outlined in *Forest Hydrology Part II (Haupt, 1976)*. The stability of a stream channel is an important indicator of where a threshold of concern should be set. As water yields increase as a result of canopy removal, the amount of water flowing in a creek gradually increases. When these increases reach a certain level, the bed and banks may begin to erode. More stable streams will be able to handle larger increases in water yield before they begin to erode, while less stable streams will experience erosion at more moderate water-yield increases.

### *RISK-ASSESSMENT CRITERIA*

Where risk is assessed in both sediment-delivery and water-yield analyses, the following definitions apply to the level of risk reported:

- low risk means impacts are unlikely to result from proposed activities,
- moderate risk means there is approximately a 50-percent chance of impacts resulting from proposed activities, and
- high risk means impacts are likely to result from proposed activities.

Where levels or degrees of impacts are assessed in this analysis, the following definitions apply to the degree of impacts reported:

- very low impact means that impacts from proposed activities are unlikely to be measurable or detectable and are not likely to be detrimental to the water resource;
- low impact means that impacts from proposed activities would likely be measurable or detectable, but are not likely to be detrimental to the water resource;
- moderate impact means that impacts from proposed activities would likely be measurable or detectable, and may or may not be detrimental to the water resource; and
- high impact means that impacts from proposed activities would likely be measurable or detectable, and are likely to have detrimental impacts to the water resource.

## ANALYSIS AREA

### ➢ *SEDIMENT DELIVERY*

The analysis area for sediment delivery is the Three Creeks Timber Sale Project area and the proposed haul routes. This includes portions of the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds. South Fork Lost Creek is a 10,503-acre, perennial, third-order tributary to Lost Creek and Swan River. The Cilly Creek watershed is a 5,266-acre third-order tributary to Swan River. The Soup Creek watershed is a 9,787-acre third-order tributary to Swan River. Analysis

will cover stream segments within these watersheds that may be affected by the proposed project and all roads and upland sites that may contribute sediment to South Fork Lost, Cilly, or Soup creeks.

- ***WATER YIELD***

The analysis areas for water yield are the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds. The South Fork Lost Creek is a 10,503-acre third-order watershed. Precipitation in the South Fork Lost Creek watershed ranges from 30 inches at its confluence with North Fork Lost Creek to 90 inches at the ridge tops. The Cilly Creek watershed is a 5,266-acre tributary to Swan River; annual precipitation ranges from 30 inches in the lower elevations to 80 inches at the ridge tops. The Soup Creek watershed is a 9,787-acre tributary to Swan River; annual precipitation ranges from 30 inches in the lower elevations to 90 inches at the ridge tops.

## EXISTING CONDITIONS

### *REGULATORY FRAMEWORK*

#### Montana Surface Water-Quality Standards

According to *ARM 17.30.608 (2)(a)*, the Swan River drainage, including South Fork Lost, Cilly, and Soup creeks, is classified as B-1. Among other criteria for B-1 waters, no increases are allowed above naturally occurring levels of sediment, and minimal increases over natural turbidity. "Naturally occurring," as defined by *ARM 17.30.602 (17)*, includes conditions or materials present during runoff from developed land where all reasonable land, soil, and water conservation prac-tic-es (commonly called BMPs) have been applied. Reasonable prac-tices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after completion of potentially impactive activities.

Designated beneficial water uses within the project area include cold-water fisheries and recreational use in the stream, wetlands, lake, and surrounding area. The Cilly Creek watershed has domestic water use and irrigation water rights as beneficial uses.

#### Water-Quality-Limited Waterbodies

None of the streams in the proposed project area are currently listed as water-quality-limited waterbodies in the *1996, 2002,* or *2004 Montana 303 (d)* list. Swan Lake is currently listed on the *2004 Montana 303(d)* list, but was not listed in the 1996 list. The 303(d) list is compiled by the Montana Department of Environmental Quality (DEQ) as required by *Section 303(d)* of the *Federal Clean Water Act* and the *Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (40 CFR, Part 130)*. Under these laws, DEQ is required to identify waterbodies that do not fully meet water-quality standards, or where beneficial uses are threatened or impaired. These waterbodies are then characterized as "water quality limited" and thus targeted for TMDL development. The TMDL process is used to determine the total allowable amount of pollutants in a waterbody of a watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water-quality standards.

The *Montana Water Quality Act (MCA 75-5-701* through *705)* also directs DEQ to assess the quality of State waters, ensure that sufficient and credible data exists to support a 303(d) listing, and develop TMDL for those waters identified as

threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint-source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices. DNRC will comply with the TMDL Law and interim guidance developed by DEQ through implementation of all reasonable soil and water conservation practices, including BMPs and the Rules.

Swan Lake is currently listed as threatened for aquatic life support and for cold-water fisheries. The current listed cause of impairment in Swan Lake is siltation; the probable sources include building construction, highway/road/bridge construction, logging road construction and maintenance, and silviculture. Through the Swan Lake Watershed Group and its associated Swan Lake Technical Advisory Group, a water-quality restoration plan was developed for Swan Lake in June 2004. The Swan Lake Watershed Group and Technical Advisory Group are comprised of local stakeholders and include:

- the Swan Ecosystem Center, Flathead Lake Biological Station at Yellow Bay, and Friends of the Wild Swan;
- landowners, including the USDA Forest Service, Montana DNRC, Plum Creek Timber Company; and
- regulatory agencies, including DEQ and EPA.

The *Water Quality Restoration Plan* was approved by EPA in August 2004, and activities are ongoing to correct current sources and causes of sediment to Swan Lake and its tributaries. DNRC is an active partner and participant in this process. All proposed activities within the project area would implement actions to alleviate identified sources of sediment and comply fully with all TMDL requirements.

**Montana SMZ Law**

By the definition in *ARM 36.11.312 (3)*, the majority of the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds are class 1 streams. All of these streams and many of their tributaries have flow for more than 6 months each year. Many of these stream reaches also support fish. Some of the smaller first-order tributaries may be classified as class 2 or 3 based on site-specific conditions.

> ***SEDIMENT DELIVERY***

- ***South Fork Lost Creek***

  Based on field reconnaissance from 2003 to 2005, stream channels in the South Fork Lost Creek watershed are primarily in good to fair condition. One reach was rated in poor condition and is located on and around the section line between Sections 2 and 3 where USFS lands are intermixed with DNRC lands. The reach represents less than 5 percent of the total length of streams in the watershed and is located on both State trust and FNF lands. The primary reason for the poor-stability rating is a midchannel gravel bar that is a result of debris jams. The South Fork Lost Creek watershed has a high supply of small- to moderate-sized woody material due to large avalanche chutes in the headwater portions of the drainage. Material deposited after an avalanche is prone to forming debris jams that periodically break. With continuous forming and reforming of debris jams, gravel bars frequently form upstream of the jam features.

  Most reaches of channel were rated as B3 and B4 channels using a classification system developed by *Rosgen (1996)*. Channel types rated as "B" are typically in the 2- to 4-percent gradient range, and have a

moderate degree of meander (sinuosity). Channel-bed materials in B3 and B4 types are mainly cobble and gravel. Given the cobble and gravel beds and the gradient of these stream types, bed materials commonly move. Gravel bars have formed on point bars in these reaches (point bars are areas of natural deposition found on the inside of a meander bend). No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in *APPENDIX E - FISHERIES ANALYSIS*. Little evidence of past streamside harvesting was found, and where past logging took place in the riparian area, no deficiency of existing or potential downed woody material was apparent in the streams.

- ***Cilly Creek***

  Based on field reconnaissance from 2003 to 2005, stream reaches in the Cilly Creek watershed were rated in good to fair condition. Cilly Creek flows perennially in most reaches, but flow becomes subsurface during the summer and fall in some low-gradient reaches in the valley bottom.

  Stream reaches in the upper portions of the watershed are mainly A3 and A4 channels using a classification system developed by *Rosgen (1996)*. Channel types rated as "A" are typically steeper than 4-percent gradient and have a low degree of meander (sinuosity). Channel-bed materials in A3 and A4 types are mainly cobble and gravel. Stream reaches are mainly B4 and B5 in the lower portions of the watershed. Channel-bed materials in B4 and B5 channels are mostly gravel and coarse sand. Given the cobble, gravel, and coarse sand beds and the gradient of these stream types, bed materials commonly move. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in *APPENDIX E - FISHERIES ANALYSIS*. Little evidence of past streamside harvesting was found, and, where past logging took place in the riparian area, no deficiency of existing or potential downed woody material was apparent in the streams.

- ***Soup Creek***

  Based on field reconnaissance from 2003 to 2005, stream channels in the Soup Creek watershed are primarily in good to fair condition. An unnamed tributary to Soup Creek had reaches in the lower elevations rated in poor condition. This tributary begins in Section 23 on FNF land and flows west through Section 22 of the proposed project area. About 0.5 mile of stream on this tributary is rated in poor condition. This reach represents less than 3 percent of the total length of streams in the

watershed. The primary reason for poor reach rating is a gully cutting through an alluvial fan. Alluvial fans are areas where stream material has been deposited for millennia, are similar to a river delta, and are usually found where a stream comes out of a steep canyon onto a broad, flat valley bottom. Alluvial fans commonly have streams that shift and jump from one channel to another because the material is easily moved by flowing water. The rest of the channel stability in Soup Creek is described below.

Most reaches of the channel were classified as B3 using a classification system developed by *Rosgen (1996)*. Channel types rated as "B" are typically in the 2- to 4-percent gradient range, and have a moderate degree of meander (sinuosity). Channel bed materials in B3 types are mainly cobble with some boulders and gravel. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to support channel form and function. Woody material in a stream provides traps for sediment storage and gradient breaks to reduce erosive energy and work as flow deflectors to reduce bank erosion. Large woody debris is also assessed for its ability to provide habitat for aquatic species. These issues are discussed further in *APPENDIX E - FISHERIES ANALYSIS*. The lower reaches of the watershed flow through a series of wetlands and beaver ponds. The beaver dams can lead to changing water levels in the stream, but the wetlands and beaver ponds tend to moderate the high runoff periods and settle out sediment and channel bed materials that may be carried downstream during runoff. Past management of streamside stands occurred in the lower reaches of the watershed. Where past logging took place in the riparian area, no deficiency of existing or potential downed woody material was apparent in the stream.

- ***Road System***

The existing road system located within and leading to the proposed project area was reviewed for existing and potential sources of sediment. In-channel and out-of-channel sediment-source reviews were conducted by DNRC hydrologists and fisheries biologists, and by PBS&J Consulting (formerly Land and Water Consulting) in association with the development of the *Swan Lake Water Quality Protection Plan* and TMDL (*DEQ 2005*). Based on the sediment-source review conducted for the Swan Lake TMDL, several existing sources of sediment were identified on the existing road system. Each of the sources identified in this analysis are either found on DNRC ownership or are associated with roads that are under a Cost-Share Agreement entered into by DNRC and FNF. Most of the delivery sites are located at stream crossings, but a portion of the South Fork Lost Creek road system was also identified as a chronic source of sediment delivery to South Fork Lost Creek. On this segment of road, portions of the road fill are located within the normal high-water mark of the stream, and has over 0.5 mile of road capable of delivering sediment to the stream. Another site that was found to contribute large volumes of sediment is located in the Soup Creek canyon. An existing bridge over Soup Creek is aging and becoming rotten. The east road approach to this crossing is on a steep grade and has no surface-

drainage relief, making it a chronic source of sediment delivery. The total estimated sediment delivery from roads in the project area to South Fork Lost, Cilly, and Soup creeks are displayed in *TABLE D-1 - ESTIMATED SEDIMENT DELIVERY TO STREAMS FROM THE EXISTING ROAD SYSTEM*. These sediment-delivery values are estimates based on procedures outlined above and are not measured values.

***TABLE D-1 - ESTIMATED SEDIMENT DELIVERY TO STREAMS FROM THE EXISTING ROAD SYSTEM***

| | SOUTH FORK LOST CREEK | CILLY CREEK | SOUP CREEK |
|---|---|---|---|
| Existing tons per year | 19.8 | 2.9 | 35.6 |

Estimated sediment delivery occurs primarily at stream crossings, and sediment comes from a variety of sources. The South Fork Lost Creek and Soup Creek watersheds each contain existing crossings constructed of wood and earth that are in various stages of decay. These crossings are located on DNRC-managed lands on roads that have not been used for several decades. South Fork Lost Creek has 2 wooden bridges with log crib abutments that were constructed in the 1960s; the wood is very rotten and the bridge decking is starting to collapse. These 2 sites are not currently a major source of sediment in the watershed, but the bridges are a high risk of failure due to the decay of the wood. Each abutment is supporting 8 to 10 tons of fill material that would be washed down the creek should they fail.

In the Soup Creek watershed, 5 old crossing sites are a high risk for sediment delivery to Soup Creek. Two of these sites, located in the Soup Creek canyon, consist of dirt fill material over logs spanning the creek. The upper site has approximately 35 tons of fill material placed over the top of the logs, and the lower site has approximately 500 tons of material placed over the top of the logs. These 2 sites may contribute minor amounts of sediment to the stream during high runoff, but these bridges are a high risk of failure due to the decay of the wood. Should either or both of these structures fail, most, if not all, of the 35 tons and 500 tons of material, respectively, would be delivered to the stream. A wooden bridge in the Soup Creek canyon is constructed of log crib abutments and is very decayed. This site was identified in the *Swan Lake Water Quality Protection Plan (DEQ, 2005)* as a major source of sediment in the Swan Lake watershed due to lack of surface drainage and erosion control on the road surface approaching the bridge. In addition to this finding, the site is a high risk of failure due to decay of the wood on the bridge abutments. Each abutment is supporting 8 to 10 tons of fill material that would be washed down the creek should they fail.

Two additional old bridge sites exist in the lower reaches of the Soup Creek watershed. One is the original Swan Highway bridge site. The deck was removed years ago, but the wooden bridge abutments are still in place and are badly decaying. Each abutment is supporting 8 to 10 tons of fill material that would be washed down the creek should they fail. The other, an old wooden bridge site with no decking, is located on a secondary road off Soup Creek Road. The log stringers and abutments are still in place, but are decaying to the point that the bridge is a high risk of failure. The bridge

abutments are supporting 8 to 10 tons of fill material that would be washed down the creek should they fail.

Other sources of sediment delivery found during the inventory are located on sites needing additional erosion control and BMP upgrades. These sites occur on older roads that were constructed before the adoption of forest management BMPs.

Much of the existing road system in the proposed project area meets applicable BMPs. Past project work installed surface drainage on the road systems in the lower portions of the Soup Creek and Cilly Creek watersheds.

- ***WATER YIELD***

According to *ARM 36.11.423*, allowable water-yield increase values were set at levels to ensure compliance with all water-quality standards, protect beneficial uses, and exhibit a low to moderate degree of risk. All allowable water-yield increases in project-area watersheds were set using a low level of risk. This means that the allowable level is a point below which water yields are unlikely to cause any measurable or detectable changes in channel stability. The allowable water-yield increase for the South Fork Lost Creek watershed has been set at 10 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in South Fork Lost Creek reaches the estimated level of 2,626 acres. The allowable water-yield increase for the Cilly Creek watershed has been set at 11 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in Cilly Creek reaches the estimated level of 1,448 acres. The allowable water-yield increase for the Soup Creek watershed has been set at 9 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached approximately when the ECA level in Soup Creek reaches an estimated 2,202 acres. Based on review of 1963 aerial photography and DNRC section records in the project area, timber-harvesting and associated road-construction activities have taken place in the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds since the 1950s. These activities, combined with the vegetative recovery that has occurred, have led to an estimated 1.2-percent water-yield increase over an unharvested condition in the South Fork Lost Creek watershed, 2.3 percent over an unharvested condition in Cilly Creek, and 1.0 percent over an unharvested condition in Soup Creek. *TABLE D-2 – CURRENT WATER-YIELD AND ECA INCREASES IN THREE CREEKS PROJECT AREA* summarizes the existing conditions for water yield in the project area watersheds. Estimated water yield

***TABLE D-2 – CURRENT WATER-YIELD AND ECA INCREASES IN THREE CREEKS PROJECT AREA***

| | South Fork Lost Creek | Cilly Creek | Soup Creek |
|---|---|---|---|
| Existing % water-yield increase | 1.2 | 2.3 | 1.0 |
| Allowable % water-yield increase | 10 | 11 | 9 |
| Existing ECA | 310 | 348 | 428 |
| Allowable ECA | 2,626 | 1,448 | 2,202 |

and ECA levels are very low in all 3 watersheds.

## ALTERNATIVE EFFECTS

### *SEDIMENT DELIVERY*

### Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Sediment Delivery***

  No-Action Alternative A would have no direct effects to sediment delivery beyond those currently occurring. Existing sources of sediment, both in channel and out of channel, would continue to recover or degrade based on natural or preexisting conditions.

  Indirect effects of No-Action Alternative A would be an increased risk of sediment delivery to streams from crossings that do not meet applicable BMPs. These sites would continue to pose a risk of sediment delivery to streams until other funding became available to repair them.

- ***Direct and Indirect Effects to Sediment Delivery Common to Action Alternatives B, C, D and E***

  Each of the proposed action alternatives would replace the wooden bridge over Soup Creek on Soup Creek Canyon Road. Each action alternative would also permanently remove and rehabilitate 2 log-and-earth-fill crossings in the upper reaches of Soup Creek, an old wooden bridge in the lower portion of the Soup Creek watershed, and 2 old wooden bridges on South Fork Lost Creek; the abutments and fill from the original Swan Highway bridge in the lower reaches of Soup Creek would also be permanently removed and rehabilitated.

  Replacement of the existing bridge over Soup Creek on the Soup Creek Canyon Road would involve removal of the log crib walls and the fill material they are currently retaining. The existing structure is beginning to decay and, over time, would become an increasing risk of failure due to decay in the wood. A potential failure of the wood cribbing could allow several tons of sediment to enter the stream. The proposed new bridge would be designed to allow the stream to flow freely through with no constriction of the bank-full channel. This would reduce the potential for bank erosion and channel downcutting that may occur with vertical bridge abutments. The new crossing would also redesign the road approach on the north side of Soup Creek to allow runoff to be diverted from the road surface away from the crossing site in both directions. These improvements would lead to a decrease in delivery of approximately 23.8 tons of sediment per year at this site.

  Removal and rehabilitation of the 2 log/earth crossings in the upper Soup Creek canyon would remove 2 potential sources of sediment. As stated above, these 2 sites contain 500 to 600 tons of fill material. Removal of this material and disposal outside of the SMZ would remove the risk of this material being delivered to Soup Creek and Swan River. In the short term, increases in the risk of sediment delivery at rehabilitated sites would increase. This risk would be highest in the year immediately following the rehabilitation activity and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The rehabilitation activity would produce some direct sediment delivery, but this would be minimized through the application of sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a DFWP fisheries biologist.

  Removal and rehabilitation of the 2 wooden bridges over South Fork Lost Creek, the existing wooden bridge in the lower Soup Creek

watershed, and the existing log cribs and abutments on the old Swan Highway bridge site would remove potential sources of sediment. As stated above, each of these 4 sites contain 16 to 20 tons of fill material (8 to 10 tons behind each abutment). Removal of this material and disposal outside of the SMZ would remove the risk of this material being delivered to Soup Creek and Swan River. In the short term, increases in the risk of sediment delivery at rehabilitated sites would increase. This risk would be highest in the year immediately following the rehabilitation activity and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The rehabilitation activity would produce some direct sediment delivery, but this would be minimized through applying sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a DFWP fisheries biologist.

Where South Fork Lost Creek Road exists very near or within the bankfull channel of South Fork Lost Creek, portions of the road would be permanently closed and rehabilitated. The road would be relocated up the slope, in general keeping the road 200 feet or more away from the stream. No live stream crossings would be required for the new construction, and the old road would be rehabilitated, revegetated, and permanently reclaimed. This would reduce the estimated sediment delivery to South Fork Lost Creek by approximately 18.9 tons per year from the existing condition. In the short term, increases in the risk of sediment delivery at rehabilitated sites would increase. This risk would be highest in the year immediately following the rehabilitation activity and would decrease within 2 to 3 years to below preproject levels as bare soil revegetates. The rehabilitation activity would produce some direct sediment delivery, but this would be minimized through the application of sediment-control measures as prescribed by a DNRC hydrologist and fisheries biologist and a fisheries biologist from DFWP.

- ***Direct and Indirect Effects of Action Alternative B to Sediment Delivery***

Several stream crossings would be replaced in the watersheds of the proposed project area and along the proposed haul routes, and erosion control and BMPs would be improved on approximately 47 miles of existing road. This work would:

- decrease the estimated sediment load to South Fork Lost Creek by an additional 0.4 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 19.3 tons of sediment per year;
- reduce the estimated sediment load to Cilly Creek by approximately 1.0 ton per year; and
- reduce the estimated sediment load to Soup Creek by an additional 9.8 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 33.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment delivery estimates is

found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED.*

Action Alternative B would also construct approximately 13.0 miles of new road and approximately 5.3 miles of temporary road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and the implementation of other BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned road would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative B proposes to replace 4 existing stream crossings in the proposed project area. Two replacements are existing culverts on unnamed tributaries to Soup Creek, one is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road, and the fourth is an existing culvert on an unnamed tributary between Cilly Creek and South Fork Lost Creek that does not deliver surface flow to a stream. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on the Soup Creek Canyon Road and a new culvert would be required on the following stream crossing sites: two unnamed tributaries to Soup Creek and the unnamed tributary between Cilly Creek and South Fork Lost Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and would comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Two new stream crossings proposed with Action Alternative B would be installed in the upper reaches of an unnamed tributary to Soup Creek that flows through Section 22 of the proposed project area. These crossings would be located in deep "v" shaped valleys with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossings, cutslopes would be much higher than those on standard stream crossings. This type of road construction does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at these sites is associated with the cutslopes and road travel surface. This

increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope failures fill and plug the road ditches. With all applicable BMPs in place at these sites, the risk of erosion problems sending sediment to a stream is moderate. This means that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial uses.

Action Alternative B would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, Rules, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. These activities would follow all requirements of the SMZ Law and Forest Management Rules, and would have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

- ***Direct and Indirect Effects of Action Alternative C to Sediment Delivery***

Several stream crossings in the proposed project area watersheds and along the proposed haul route would be replaced, and erosion control and BMPs would be improved on approximately 65 miles of existing road. This work would:

- decrease the estimated sediment load to South Fork Lost Creek by an additional 0.4 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 19.3 tons of sediment per year;
- reduce the estimated sediment load to Cilly Creek by approximately 1.0 ton per year; and
- reduce the estimated sediment load to Soup Creek by an additional 9.8 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 33.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road

construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment delivery estimates is found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative C would also construct approximately 12.4 miles of new road and approximately 6.9 miles of temporary road to access proposed harvest units. The impacts of proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and the implementation of other BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned road would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative C proposes to replace 4 existing stream crossings in the proposed project area. Two replacements are existing culverts on unnamed tributaries to Soup Creek, one is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road, and the fourth is an existing culvert on an unnamed tributary between Cilly Creek and South Fork Lost Creek that does not deliver surface flow to a stream. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on Soup Creek Canyon Road, and new culverts would be required on the following stream-crossing sites: two unnamed tributaries to Soup Creek and the unnamed tributary between Cilly Creek and South Fork Lost Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short-term and comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Two new stream crossings proposed with Action Alternative C would be installed in the upper reaches of an unnamed tributary to Soup Creek flowing through Section 22 of the proposed project area. These crossings would be located in deep "v" shaped valleys with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossings, cutslopes would be much higher than those on standard stream crossings. This type of road construction does not use fill material; all material

cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at these sites is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope failures fill and plug the road ditches. With all applicable BMPs in place at these sites, the risk of erosion problems sending sediment to a stream is moderate. This means that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial use.

Action Alternative C would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, Rules, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. These activities would follow all requirements of the SMZ Law and the *Rules*, and would have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

- ***Direct and Indirect Effects of Action Alternative D to Sediment Delivery***

Several stream crossings would be replaced in the proposed project-area watersheds and along the proposed haul route, and erosion control and BMPs would be improved on approximately 84 miles of existing road. This work would create an estimated net increase of 0.6 tons of sediment load to South Fork Lost Creek. This projected increase, when combined with the estimated reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, amounts to:

- a total estimated reduction of approximately 18.7 tons of sediment per year;
- a reduction in the estimated sediment load to Cilly Creek by approximately 0.6 ton per year; and
- a reduction in the estimated sediment load to Soup Creek by an additional 9.8 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D and E*, for a total reduction of approximately 33.6 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment-delivery estimates is found in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative D would also construct approximately 15.6 miles of new road and approximately 3.9 miles of temporary road to access proposed harvest units. The impacts of the proposed new roads are primarily associated with new stream crossings. These impacts are discussed above, and in *TABLE D-3 (4, 5) – ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and other implementations of BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned roads would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative D proposes to replace 5 existing stream crossings in the proposed project area. Two replacements are existing culverts on unnamed tributaries to Soup Creek, one is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road, and the fourth is an existing culvert on an unnamed tributary between Cilly Creek and South Lost Creek that does not deliver surface flow to a stream. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on Soup Creek Canyon Road and new culverts would be required on the following stream crossing sites: two unnamed tributaries to Soup Creek, an existing Cliff Creek culvert, and the unnamed tributary between Cilly Creek and South Fork Lost Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Two new stream crossings proposed with Action Alternative D would be installed in the upper reaches of an unnamed tributary to Soup Creek that flows through Section 22 of the proposed project area. Action Alternative D also proposes to install a new stream crossing in the upper reaches of Cilly Creek

in the eastern portion of Section 14. These crossings would be located in deep "v" shaped valleys with steep sideslopes (60 to 80 percent). Due to the steepness of the sideslopes coming into the proposed crossings, cutslopes would be much higher than those on standard stream crossings. This type of road construction does not use fill material; all material cut in order to construct these portions of road would be hauled away in trucks, so the only risk to assess at these sites is associated with the cutslopes and road travel surface. This increase in cutslope height would increase the risk of cutslope material being eroded and routed to streams. The soil parent material is glacial till at these sites, which also may increase the risk of material either being eroded or having small cutslope sloughs fill and plug the road ditches. With all applicable BMPs in place at these sites, the risk of erosion problems sending sediment to a stream is moderate. This means that there is approximately a 50-percent chance that impacts may occur as a result of construction. Potential impacts to water quality are moderate. Therefore, if impacts would occur, they would be detectable or measurable, and these impacts may or may not be detrimental to downstream beneficial uses.

Action Alternative D would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, *Rules*, and all applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. These activities would follow all requirements of the SMZ Law and the *Rules* and have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

- ***Direct and Indirect Effects of Action Alternative E to Sediment Delivery***

Several stream crossings would be replaced in the proposed project area watersheds and along the proposed haul route, and erosion control and BMPs would be improved on approximately 90 miles of existing road. This work would create an estimated net increase of 0.6 tons of sediment load to South Fork Lost Creek. This projected increase when combined with the estimated reduction shown in *Effects Common to Action Alternatives B, C, D, and E* amounts to:

- a total estimated reduction of approximately 18.7 tons of sediment per year;
- a reduction in the estimated sediment load to Cilly Creek by approximately 1.0 ton per year,

and a reduction in the estimated sediment load to Soup Creek by an additional 10.1 tons of sediment beyond the reduction shown in *Effects Common to Action Alternatives B, C, D, and E*, for a total reduction of approximately 33.9 tons per year.

These projected sediment reductions are net values for each watershed. These values include the projected increases in sediment delivery from new stream crossings and new road construction, as well as projected sediment reductions from BMP improvements and road and stream-crossing rehabilitation and removal. A more detailed summary of sediment delivery estimates can be found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*.

Action Alternative E would also construct approximately 8.2 miles of new road and approximately 4.8 miles of temporary road to access proposed harvest units. The impacts of the proposed new roads are primarily associated with new stream crossings. These impacts are discussed above and in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED*. The remainder of the impacts of new and temporary road construction is related to the risk of erosion resulting from exposure of bare soil. The risk of sediment delivery from new permanent roads is low where these roads are located away from stream crossings. As cutslopes and fillslopes revegetate, this risk would decrease. Installation of surface drainage and the implementation of other BMPs and the *Rules* would further reduce the risk of erosion or sediment delivery from new roads. Temporary roads would be decommissioned immediately following the completion of activities in the proposed units. The decommissioned roads would present an increased risk of sediment delivery until bare soil is revegetated.

Action Alternative E proposes to replace 5 existing stream crossings in the proposed project area. Two are existing culverts on unnamed tributaries to Soup Creek, one is the existing wooden bridge over Soup Creek on Soup Creek Canyon Road, and the fourth is an existing culvert on an unnamed tributary between Cilly Creek and South Fork Lost Creek that does not deliver surface flow to a stream. Crossings proposed for replacement do not currently meet all applicable BMPs; in order to meet applicable standards, a bridge would be required on Soup Creek Canyon Road and a new culvert would be required on the following stream crossing sites: 2 unnamed tributaries to Soup Creek, an existing Cliff Creek culvert, and the unnamed tributary between Cilly Creek and South Fork Lost Creek. The replacement of existing stream crossings would contribute sediment directly to the streams where work would be conducted. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with applicable permits and State water-quality laws. In addition, several sites would have additional erosion control added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

Action Alternative E would have a low risk of sediment delivery to streams as a result of proposed timber-harvesting activities. The SMZ law, *Rules*, and applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. The Montana BMP audit process has been used to evaluate the application and effectiveness of BMPs since 1990; this process has also been used to evaluate the application and effectiveness of the SMZ Law since 1996. During that time, evaluation of ground-based skidding practices near riparian areas has been rated 92-percent effective, and these same practices have been found effective over 99 percent of the time from 1998 to present (*DNRC, 1990* through *2004*). Since 1996, effectiveness of the SMZ width has been rated over 99 percent (*DNRC, 1990* through *2004*). As a result, with the application of BMPs and the SMZ Law, proposed activities are expected to have a low risk of low impacts to sediment delivery.

Harvesting activities are proposed within the South Fork Lost Creek and Cilly Creek SMZs. This harvesting activity would follow all requirements of the SMZ Law and the *Rules* and would have a low risk of affecting channel stability and sediment transport through reduced recruitment of large woody material to South Fork Lost Creek, Cilly Creek, or their tributaries. A more in-depth discussion of the impacts of riparian harvesting can be found in *APPENDIX E - FISHERIES ANALYSIS*.

### *CUMULATIVE EFFECTS*

- ***Cumulative Effects of No-Action Alternative A to Sediment Delivery***

The cumulative effects would be very similar to those described in the *EXISTING CONDITIONS* portion of this analysis. All existing sources of sediment would continue to recover or degrade as dictated by natural and preexisting conditions until a source of funding became available to repair them. Sediment loads would remain at or near present levels.

- ***Cumulative Effects of Action Alternative B to Sediment Delivery***

Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. Sediment generated from the replacement of existing culverts would increase the total sediment load in project area streams for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 0.5 tons of sediment per year in South Fork Lost Creek, reduced from 2.9 tons per year to approximately 1.9 tons per year in Cilly Creek, and reduced from 35.6 tons per year to 1.9 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from the replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from upgrading surface drainage, erosion control, and BMPs on existing roads. A summary of sediment-delivery estimates is found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN THE SOUP CREEK (CILLY CREEK, SOUTH FORK LOST CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and

stabilize. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. The improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks as described above. In the short term, new road construction and the installation and improvement of surface drainage features would expose bare soil. This would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within an SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced downed woody material in South Fork Lost, Cilly, and Soup creeks or their tributaries. Tree-retention requirements of the SMZ Law and Forest Management Rules would ensure a future supply of woody material to project area creeks. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative B has a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and Forest Management Rules would ensure low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative C to Sediment Delivery***

Cumulative effects would be primarily related to roadwork and stream-crossing replacements. The sediment generated from the replacement of existing culverts would increase the total sediment load in project-area streams for the duration of activity. These increases would not exceed any State water-quality laws, and would follow all applicable recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 0.5 tons of sediment per year in the South Fork Lost Creek, reduced from 2.9 tons per year to approximately 1.9 tons per year in Cilly Creek, and reduced from 35.6 tons per year to 1.9 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from replacement of existing stream-

crossing structures, and the projected reductions in sediment delivery from the upgrading of surface drainage, erosion control, and BMPs on existing roads. A summary of sediment delivery estimates is found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to a better design on the crossings. Improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks as described above. In the short term, new road construction and the installation and improvement of surface-drainage features would expose bare soil. This would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the expected sediment delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

Harvesting of trees within a SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced downed woody material in South Fork Lost, Cilly, and Soup Creek or their tributaries. Tree-retention requirements of the SMZ Law and the *Rules* would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative C has a low risk of adverse cumulative impacts to sediment yield in project area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and the *Rules* would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, *Rules*, and regulations.

- ***Cumulative Effects of Action Alternative D to Sediment Delivery***

Cumulative effects would be primarily related to roadwork and stream-crossing replacements. The sediment generated from the replacement of existing culverts would increase the total sediment load in project-area streams for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable

recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 1.1 tons of sediment per year in South Fork Lost Creek, reduced from 2.9 tons per year to approximately 2.3 tons per year in Cilly Creek, and reduced from 35.6 tons per year to 1.9 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from the upgrading of surface drainage, erosion control, and BMPs on existing roads. A summary of sediment-delivery estimates is found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN THE SOUP CREEK (CILLY CREEK, SOUTH FORK LOST CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to a better design on the crossings. Improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and the installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup Creek as described above. In the short term, new road construction and the installation and improvement of surface-drainage features would expose bare soil. This would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the expected sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within an SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced downed woody material in South Fork Lost, Cilly, and Soup creeks or their tributaries. Tree-retention requirements of the SMZ Law and the *Rules* would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative D has a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affecting downstream beneficial uses. Implementation of BMPs, the SMZ Law, and the *Rules* would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce

cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, *Rules*, and regulations.

- ***Cumulative Effects of Action Alternative E to Sediment Delivery***

Cumulative effects would be primarily related to roadwork and stream-crossing replacements. The sediment generated from the replacement of existing culverts would increase the total sediment load in project-area streams for the duration of activity. These increases would not exceed any State water-quality laws, and would follow all applicable recommendations given in the 124 and 318 permits. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 19.8 tons of sediment per year to approximately 1.1 tons of sediment per year in South Fork Lost Creek, reduced from 2.9 tons per year to approximately 1.9 tons per year in Cilly Creek, and reduced from 35.6 tons per year to 1.7 tons per year in Soup Creek. These values include projected increases from new road and stream-crossing construction, potential increases from the replacement of existing stream-crossing structures, and the projected reductions in sediment delivery from the upgrading of surface drainage, erosion control, and BMPs on existing roads. A summary of sediment delivery estimates is found in *TABLE D-3 (4, 5) - ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST (CILLY CREEK, SOUP CREEK) WATERSHED* at the end of the *SEDIMENT DELIVERY* effects. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites are closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to better design on the crossings. Improved design would reduce the risk of failure of the structures, which would reduce the risk of sediment delivery to Swan River and other downstream waters.

The construction of new roads and stream crossings and the installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks as described above. In the short term, new road construction and the installation and improvement of surface-drainage features would expose bare soil. This would increase the risk of short-term sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would minimize the risk of potential short-term sediment loading to downstream waters. Over the long term, cumulative sediment delivery to South Fork Lost, Cilly, and Soup creeks are projected to be lower than existing conditions. Projected increases in sediment delivery from new road and stream-crossing construction would be far less than the sediment-delivery decreases expected with the installation of more effective surface-drainage and erosion-control features on the existing road system. The net long-term effect to sediment delivery from this alternative is expected to be a cumulative decrease from preproject levels.

The harvesting of trees within an SMZ would have a low risk of adverse cumulative effects to channel stability and sediment transport due to reduced downed woody material in South Fork Lost, Cilly, and Soup creeks or their tributaries. Tree-retention

requirements of the SMZ Law and the *Rules* would ensure a future supply of woody material to creeks in the project area. A more in-depth discussion of the impacts of riparian harvesting is discussed in *APPENDIX E - FISHERIES ANALYSIS*.

Action Alternative E has a low risk of adverse cumulative impacts to sediment yield in project-area watersheds and presents a low risk to adversely affect downstream beneficial uses. Implementation of BMPs, the SMZ Law, and the *Rules* would ensure a low risk of increased sediment delivery, and improvements to the existing road system would substantially reduce cumulative levels of sedimentation from current levels. All activities would comply with applicable laws, *Rules*, and regulations.

***TABLE D-3 - ESTIMATES OF SEDIMENT DELIVERY IN THE SOUTH FORK LOST CREEK WATERSHED***

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Existing delivery (tons/year) | 19.8 | 19.8 | 19.8 | 19.8 | 19.8 |
| Estimated reduction[2] | 0.0 | 19.3 | 19.3 | 19.3 | 19.3 |
| Estimated increase[3] | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 |
| Post-project delivery (tons/year) | 19.8 | 0.5 | 0.5 | 1.1 | 1.1 |
| Reduction (tons/year)[1] | 0 | 19.3 | 19.3 | 18.7 | 18.7 |
| Percent reduction[4] | 0 | 97% | 97% | 94% | 94% |

[1]*These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.*
[2]*Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.*
[3]*Includes projected increases from construction of new roads and new stream crossings.*
[4]*Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values.*

***TABLE D-4 - ESTIMATES OF SEDIMENT DELIVERY IN THE CILLY CREEK WATERSHED***

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Existing delivery (tons/year)[1] | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 |
| Estimated reduction[2] | 0.0 | 1.4 | 1.4 | 1.4 | 1.4 |
| Estimated increase[3] | 0.0 | 0.4 | 0.4 | 0.8 | 0.4 |
| Postproject delivery (tons/year) | 2.9 | 1.9 | 1.9 | 2.3 | 1.9 |
| Reduction (tons/year)[1] | 0 | 1.0 | 1.0 | 0.6 | 1.0 |
| Percent reduction[4] | 0 | 34% | 34% | 21% | 34% |

[1]*These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.*
[2]*Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.*
[3]*Includes projected increases from construction of new roads and new stream crossings.*
[4]*Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values.*

*TABLE D-5 - ESTIMATES OF SEDIMENT DELIVERY IN THE SOUP CREEK WATERSHED*

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Existing delivery (tons/year)[1] | 35.6 | 35.6 | 35.6 | 35.6 | 35.6 |
| Estimated reduction[2] | 0.0 | 34.3 | 34.3 | 34.3 | 34.3 |
| Estimated increase[3] | 0.0 | 0.7 | 0.7 | 0.7 | 0.4 |
| Postproject delivery (tons/year) | 35.6 | 2.0 | 2.0 | 2.0 | 1.7 |
| Reduction (tons/year)[3] | 0 | 33.6 | 33.6 | 33.6 | 33.9 |
| Percent reduction[4] | 0 | 95% | 95% | 95% | 95% |

*[1]These sediment-delivery values are estimates based on procedures outlined in Analysis Methods, and are not measured values.*
*[2]Includes projected decreases from rehabilitation and BMP work on existing roads and crossings.*
*[3]Includes projected increases from construction of new roads and new stream crossings.*
*[4]Percent reduction values are estimates based on procedures outlined in Analysis Methods, not on measured values.*

### *WATER YIELD*

**Direct and Indirect Effects**

- ***Direct and Indirect Effects of No-Action Alternative A to Water Yield***

  No-Action Alternative A would have no direct or indirect effects on water yield. Water quantity would not be changed from present levels and the harvest units would continue to return to fully forested conditions as areas of historic timber-harvests regenerate.

- ***Direct and Indirect Effects of Action Alternative B to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 0.6 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 6.8 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 2.1 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include water yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities; this will be discussed in *Cumulative Effects* portion of this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams.

- ***Direct and Indirect Effects of Action Alternative C to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 0.5 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 6.4 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 1.5 percent over the current level. These levels of projected water-yield increase are incremental values that refer only to water yield generated by this action alternative and do not include water-yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities and will be discussed later in this analysis. These levels of water-yield increases would produce a low risk of

creating unstable channels in any of the project-area streams.

- ***Direct and Indirect Effects of Action Alternative D to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 1.3 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 9.3 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 1.1 percent over the current level. These levels of projected water-yield increases are incremental values that refer only to water yield generated by this action alternative and do not include water-yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities and will be discussed later in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the project-area streams.

- ***Direct and Indirect Effects of Action Alternative E to Water Yield***

  The annual water yield in the South Fork Lost Creek watershed would increase by an estimated 1.2 percent over the current level. The annual water yield in the Cilly Creek watershed would increase by an estimated 9.6 percent over the current level. The annual water yield in the Soup Creek watershed would increase by an estimated 0.9 percent over the current level. These levels of projected water-yield increases are incremental values that refer only to water yield generated by this action alternative and do not include water-yield increases from past activities. The cumulative water-yield increase will assess the impacts of the proposed action alternative when added to the impacts of past and planned future activities and will be discussed later in this analysis. These levels of water-yield increases would produce a low risk of creating unstable channels in any of the streams in the project area.

**Cumulative Effects**

- ***Cumulative Effects of No-Action Alternative A on Water Yield***

  No cumulative effects on water yield would be expected. Existing harvest units would continue to revegetate and move closer to premanagement levels of water use and snowpack distribution.

- ***Cumulative Effects of Action Alternative B on Water Yield***

  The removal of trees proposed in Action Alternative B would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent over unharvested to an estimated 1.8 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from this alternative leaves the watershed well below the established threshold of concern established in the *EXISTING CONDITIONS* portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

  The removal of trees proposed in Action Alternative B would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent over unharvested to an

estimated 9.1 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed below the established threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Cilly Creek or its tributaries.

The removal of trees proposed in Action Alternative B would increase the water yield in the Soup Creek watershed from its current level of approximately 1.0 percent over unharvested to an estimated 3.1 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative B leaves the watershed below the established threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative B is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative B to the South Fork Lost Creek and Cilly Creek watersheds and Soup Creek drainage is found in *TABLE D-6 (7, 8) – WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED.*

- ***Cumulative Effects of Action Alternative C on Water Yield***

The removal of trees proposed in Action Alternative C would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent over unharvested to an estimated 1.7 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed well below the threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

The removal of trees proposed in Action Alternative C would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent over unharvested to an estimated 8.7 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past-management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed below the established threshold of concern established in the existing-conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Cilly Creek or its tributaries.

The removal of trees proposed in Action Alternative C would

increase the water yield in the Soup Creek watershed from its current level of approximately 1.0 percent over unharvested to an estimated 2.5 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Soup Creek watershed. The water-yield increase expected from Action Alternative C leaves the watershed well below the established threshold of concern established in the existing-conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative C is expected to have a low risk of cumulative impacts to water yield as a result of the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative C to the South Fork Lost Creek and Cilly Creek watersheds and the Soup Creek drainage is found in *TABLE D-6 (7, 8) - WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED.*

- ***Cumulative Effects of Action Alternative D on Water Yield***

The removal of trees proposed in Action Alternative D would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent over unharvested to an estimated 2.5 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed well below the threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

The removal of trees proposed in Action Alternative D would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent over unharvested to an estimated 11.6 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed slightly above the established threshold of concern. It is possible that increases in flow could be observed through the implementation of Action Alternative D. Changes in channel conditions are unlikely, but could occur in individual reaches that have lower channel stability. These changes could include increased streambank erosion, channel down-cutting, and migration of channels away from current locations. Should in-channel erosion occur, deposition of bed and bank material could be deposited in flatter, gentler reaches. Deposition of cobble and gravel material in high enough quantities could lead to additional reaches of Cilly Creek losing surface flow during summer and fall months due to porous bed materials. Another possibility of the projected water-yield increases is that reaches of Cilly Creek that currently have subsurface flow during summer and fall months could have surface flow for a longer period of time

or become perennial due to a higher volume of water available. These projections are unlikely given the channel-stability ratings of Cilly Creek, and Action Alternative D would most likely not have measurable impacts to the stream channel. However, the estimated water-yield increases would leave a low to moderate risk of the described potential negative impacts in the less stable reaches and in isolated instances.

The removal of trees proposed in Action Alternative D would increase water yield in the Soup Creek watershed from its current level of approximately 1.0 percent over unharvested to an estimated 2.1 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Soup Creek watershed. The water-yield increase expected from Action Alternative D leaves the watershed well below the established threshold of concern established in the *EXISTING CONDITIONS* portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative D is expected to have a low risk of detrimental cumulative impacts due to water-yield increases resulting from the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative D to the South Fork Lost Creek and Cilly Creek watersheds and the Soup Creek drainage is found in *TABLE D-6 (7, 8) - WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED.*

- ***Cumulative Effects of Action Alternative E on Water Yield***

The removal of trees proposed in Action Alternative E would increase the water yield in the South Fork Lost Creek watershed from its current level of approximately 1.2 percent over unharvested to an estimated 2.4 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the South Fork Lost Creek watershed. The water-yield increase expected from Action Alternative E leaves the watershed well below the threshold of concern established in the existing conditions portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in South Fork Lost Creek or its tributaries.

The removal of trees proposed in Action Alternative E would increase the water yield in the Cilly Creek watershed from its current level of approximately 2.3 percent over unharvested to an estimated 11.9 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Cilly Creek watershed. The water-yield increase expected from Action Alternative E leaves the watershed an estimated 0.9 percent above the established threshold of concern. It is possible that increases in flow could be observed through the implementation of Action Alternative E. Changes in channel conditions are unlikely, but could occur in individual reaches that have lower channel stability.

These changes could include increased streambank erosion, channels down-cutting, and migration of channels away from current locations. Should in-channel erosion occur, deposition of bed and bank material could be deposited in flatter, gentler reaches. Deposition of cobble and gravel material in high enough quantities could lead to additional reaches of Cilly Creek losing surface flow during summer and fall months due to porous bed materials. Another possibility of the projected water-yield increases is that reaches of Cilly Creek that currently have subsurface flow during summer and fall months could have surface flow for a longer period of time or become perennial due to a higher volume of water available. These projections are unlikely given the channel-stability ratings of Cilly Creek, and Action Alternative E would most likely not have measurable impacts to the stream channel. However, the estimated water-yield increases would leave a low to moderate risk of the described potential negative impacts in the less stable reaches and in isolated instances.

The removal of trees proposed in Action Alternative E would increase water yield in the Soup Creek watershed from its current level of approximately 1.0 percent over unharvested to an estimated 1.9 percent. This water-yield increase, and its associated ECA level, includes the impacts of all past management activities, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the Soup Creek watershed. The water-yield increase expected from Action Alternative E leaves the watershed well below the established threshold of concern established in the *EXISTING CONDITIONS* portion of this analysis. This cumulative level of water-yield increase would produce a low risk of creating unstable channels in Soup Creek or its tributaries.

Action Alternative E is expected to have a low risk of detrimental cumulative impacts due to water-yield increases resulting from the proposed timber harvesting. A summary of the anticipated water-yield impacts of Action Alternative E to the South Fork Lost Creek and Cilly Creek watersheds, and the Soup Creek drainage is found in *TABLE D-6 (7, 8) - WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK (CILLY CREEK, SOUP CREEK) WATERSHED.*

***TABLE D-6 - WATER YIELD AND ECA INCREASES IN SOUTH FORK LOST CREEK WATERSHED***

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Allowable percent water-yield increase | 10% | 10% | 10% | 10% | 10% |
| Percent water-yield increase | 1.2 | 1.8 | 1.7 | 2.5 | 2.4 |
| Acres harvested | 0 | 318 | 303 | 512 | 449 |
| Miles of new road[1] | 0 | 3.6 | 4.3 | 4.9 | 2.9 |
| ECA generated | 0 | 290 | 262 | 468 | 374 |
| Total ECA | 310 | 600 | 572 | 778 | 684 |
| Allowable ECA | 2,626 | 2,626 | 2,626 | 2,626 | 2,626 |

[1]*Includes only permanent new roads*

*TABLE D-7 - WATER YIELD AND ECA INCREASES IN THE CILLY CREEK WATERSHED*

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Allowable water-yield increase | 11% | 11% | 11% | 11% | 11% |
| Percent water-yield increase | 2.3 | 9.1 | 8.7 | 11.6 | 11.9 |
| Acres harvested | 0 | 896 | 883 | 986 | 1,140 |
| Miles of new road[1] | 0 | 2.3 | 2.3 | 5.3 | 3.8 |
| ECA generated | 0 | 703 | 691 | 782 | 947 |
| Total ECA | 348 | 1,051 | 1,039 | 1,130 | 1,295 |
| Allowable ECA | 1,448 | 1,448 | 1,448 | 1,448 | 1,448 |

[1]*Includes only permanent new roads*

*TABLE D-8 - WATER YIELD AND ECA INCREASES IN THE SOUP CREEK WATERSHED*

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Allowable water-yield increase | 9% | 9% | 9% | 9% | 9% |
| Percent water-yield increase | 1.0 | 3.1 | 2.5 | 2.1 | 1.9 |
| Acres harvested | 0 | 642 | 566 | 443 | 377 |
| Miles of new road[1] | 0 | 7.1 | 5.8 | 5.4 | 1.5 |
| ECA generated | 0 | 563 | 500 | 368 | 308 |
| Total ECA | 428 | 991 | 928 | 796 | 736 |
| Allowable ECA | 2,202 | 2,202 | 2,202 | 2,202 | 2,202 |

[1]*Includes only permanent new roads*

Appendix E
Fisheries
Analysis

## APPENDIX E
## FISHERIES ANALYSIS

### OBJECTIVE

The purpose of this analysis is to assess potential impacts to cold-water fisheries within the Three Creeks Timber Sale Project area as a result of any one of the project alternatives.

### INTRODUCTION

The Three Creeks Timber Sale Project area includes State trust lands within Sections 1, 2, 3, 4, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 22, 24, 25, 26, and 27, T24N, R17W, which all lie entirely within the Swan River drainage (*5th code HUC 17010211030*). Up to 1,999 acres of total harvest area is proposed within the project area.

The project area includes specific portions of the watersheds of 3 major tributaries of Swan River. From north to south, these are South Fork Lost, Cilly, and Soup creeks. The downstream reaches of Swan River and Lost Creek are not within the project area and will not be included in the analysis portion of the direct and indirect effects in this resource appendix. With respect to downstream fisheries, no project alternatives are expected to have measurable or detectable direct or indirect effects in the downstream reaches of Swan River and Lost Creek. Both Swan River and Lost Creek will be included in the cumulative effects analysis as deemed applicable.

South Fork Lost, Cilly, and Soup creeks are not identified on the 1996, 2002, or 2004 *Montana 303(d)* lists as impaired streams.

The Swan River drainage, including South Fork Lost, Cilly, and Soup creeks, and any contributing subbasins, is classified as B-1 in the *Montana Surface Water Quality Standards (ARM 17.30.608[b][i])*. The B-1 classification is for multiple beneficial use waters, including the growth and propagation of cold-water fisheries and associated aquatic life. Among other criteria for B-1 waters, a 1-degree Fahrenheit maximum increase above naturally occurring water temperature is allowed within the range of 32 to 66 degrees Fahrenheit (0 to 18.9 degrees Celsius), and no increases are allowed above naturally occurring concentrations of sediment or suspended sediment that will harm or prove detrimental to fish or wildlife. In regard to sediment, naturally occurring includes conditions or materials present from runoff or percolation from developed land where all reasonable land, soil, and water

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conservation practices have been applied (*ARM 17.30.603[19]*). Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses (*ARM 17.30.603[24]*). The State has adopted BMPs through its *Nonpoint Source Management Plan* as the principle means of controlling nonpoint source pollution from silvicultural activities (*Thomas et al 1990*).

**SPECIES**

Native cold-water fish species within the project area include bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), slimy sculpin (*Cottus cognatus*), largescale sucker (*Catostomus macrocheilus*), and longnose dace (*Rhinichthys cataractae*). The 1 nonnative species known to persist within the specific project area is eastern brook trout (*Salvelinus fontinalis*).

Neither slimy sculpin, largescale sucker, nor longnose dace is identified as endangered, threatened, or sensitive species (*MNHP 2004*). Although all 3 species are an integral component of the aquatic ecosystem within the project area, any foreseeable issues or concerns regarding these species' populations or habitats can be addressed through an effects analysis for bull trout and westslope cutthroat trout. Eastern brook trout is an invasive species that is not a component of the region's historical biodiversity, but any foreseeable issues or concerns regarding this species' populations or habitats can also be addressed through an effects analysis for bull trout and westslope cutthroat trout.

Bull trout and westslope cutthroat trout are the primary cold-water species that will be addressed in this analysis. The USFWS has listed bull trout as "threatened" under the *Endangered Species Act*. Both bull trout and westslope cutthroat trout are listed as Class-A Montana Animal Species of Concern. A Class-A designation is defined as a species or subspecies that has limited numbers and/or habitats both in Montana and elsewhere in North America, and elimination from Montana would be a significant loss to the gene pool of the species or subspecies (DFWP, MNHP, and *Montana Chapter American Fisheries Society Rankings*). DNRC has also identified bull trout and westslope cutthroat trout as sensitive species *(Administrative Rule of Montana [ARM] 36.11.436)*.

Both bull trout and westslope cutthroat trout exhibit resident, fluvial, and adfluvial life forms. Resident life forms spend their juvenile and adult life in natal or nearby low-order tributaries. Fluvial and adfluvial life forms generally leave their natal streams within 1 to 3 years of emergence (*Shepard et al 1984, Fraley and Shepard 1989*) to mature in downstream river and lake systems, respectively, and then return again to headwater or upstream reaches to spawn. Fluvial and adfluvial life forms of bull trout and westslope cutthroat trout are typically larger than resident fish, and bull trout have been observed returning to upstream reaches during successive or alternating years to spawn (*Fraley and Shepard 1989*). Overall, the life forms and stages of bull trout and westslope cutthroat trout have evolved to exist in sympatry (*Nakano et al 1992, Pratt 1984, Shepard et al 1984*).

Fluvial and adfluvial bull trout generally mature at ages 5 to 6, begin upstream spawning migrations in April, and spawn between September and October in response to a temperature regime decline below 9 to 10 degrees Celsius (*Fraley and Shepard 1989*). Spawning adult bull trout are known to construct redds in close association with upwelling

groundwater and proximity to overhanging or instream cover (*Fraley and Shepard 1989*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to bull trout embryo and juvenile survival (*MBTSG 1998, Weaver and Fraley 1991, Pratt 1984*).

Resident westslope cutthroat trout have been observed maturing at ages 3 to 5 (*Downs et al 1997*), and all life forms are known to spawn during May through June (*Shepard et al 1984*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to westslope cutthroat trout embryo and juvenile survival (*Pratt 1984*).

**FISHERIES-SPECIFIC ISSUES RAISED DURING SCOPING**

Issues, in respect to this environmental analysis, are not specifically defined by either MEPA or the Council on Environmental Quality. For the purposes of this environmental analysis, issues will be considered actual or perceived effects, risks, or hazards as a result of the proposed alternatives.

Fifteen written concerns and issues regarding fisheries resources were raised through public participation during the scoping process. These concerns and issues are contained in a separate document (*Public Comments to Scoping of Proposed Three Creeks Timber Sale Project - Fisheries-Related Comments*) that can be found in the project file. Each concern and issue is identified and followed with a statement describing how the concern or issue will be addressed by this analysis.

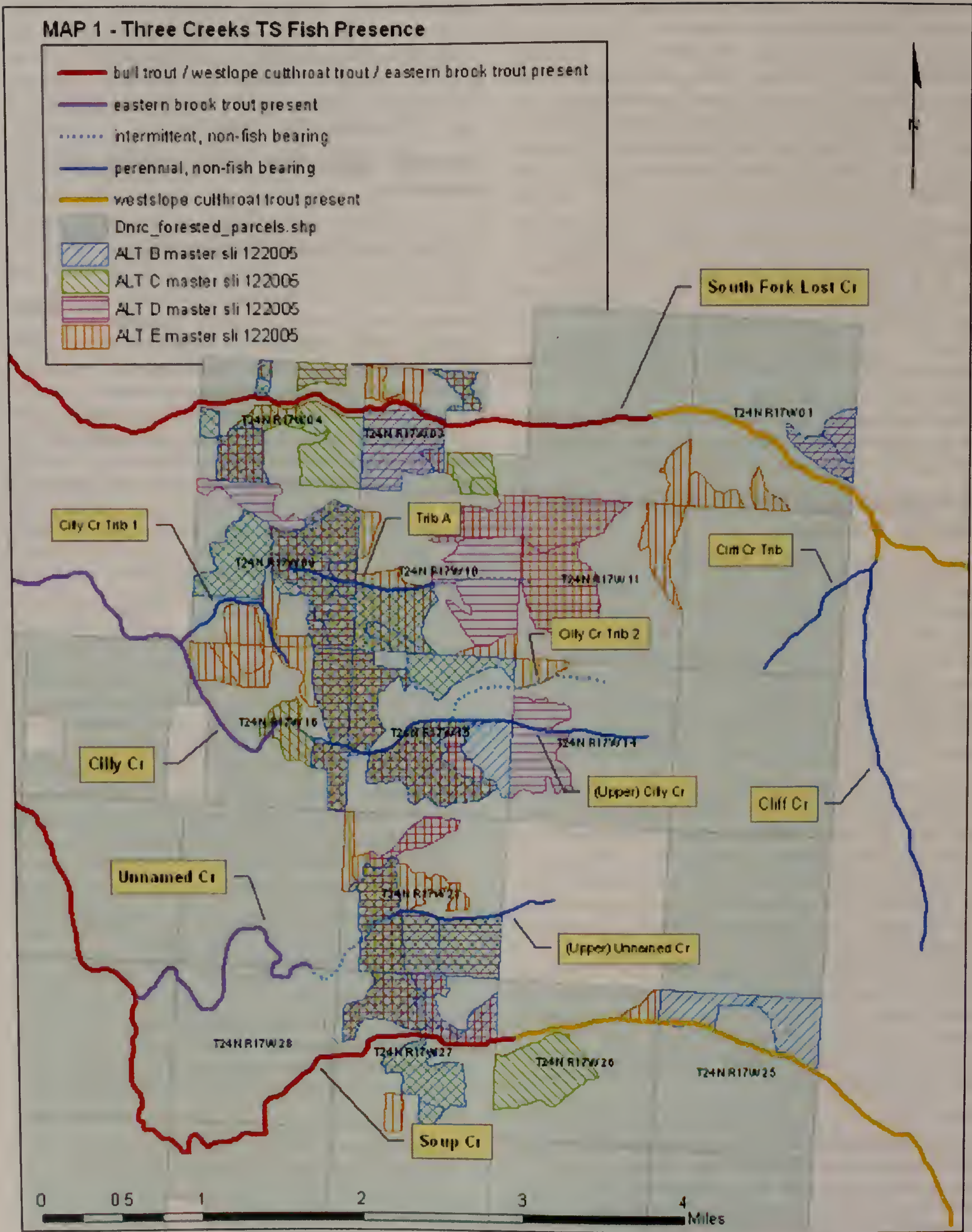
The issues raised both internally and through public comment during the scoping process are: the proposed actions may adversely affect fisheries populations and fisheries habitat features, including flow regime, sediment, channel forms, riparian function, large woody debris, stream temperature, and connectivity, in fish-bearing streams within the project area. These issues will be addressed under *EXISTING CONDITIONS* and *ENVIRONMENTAL EFFECTS*.

**STREAMS EXCLUDED FROM FISHERIES ANALYSIS**

All potential fish-bearing streams within and immediately adjacent to the project area were surveyed during 2003, 2004, and 2005 for fisheries presence (see *FIGURE 1 - THREE CREEK TIMBER SALE FISH PRESENCE*). Streams that were surveyed for fish presence and determined not to contain any fish populations or provide fish habitat are considered non-fish bearing. Non-fish-bearing stream reaches are not individually addressed in this fisheries analysis and include:

- Tributary A - Field surveys indicate that the isolated, disconnected perennial reach of this stream is non-fish-bearing.
- Cilly Creek Tributary 1 - Field surveys indicate that this tributary (except for the lowest approximately 200-foot reach of the tributary immediately upstream of Cilly Creek) does not provide fish habitat. The lowest approximately 200-foot reach provides marginal habitat for eastern brook trout.
- Cilly Creek Tributary 2 - Field surveys indicate that this tributary does not provide fish habitat.
- (Upper) Cilly Creek - Field surveys indicate that the isolated, disconnected perennial reach of this stream is non-fish-bearing.
- Cliff Creek - The lower 780 feet of this stream provides marginal habitat to westslope cutthroat trout, but this stream is outside of the project area.

*FIGURE E-1 - THREE CREEKS TIMBER SALE FISH PRESENCE*



- Cliff Creek Tributary - Field surveys indicate that the lower reach of this stream is a migration barrier, and the upper reach is non-fish-bearing.
- (Upper) Unnamed Creek - Field surveys indicate that the isolated, disconnected perennial reach of this stream is non-fish-bearing.

The streams identified above are excluded from specific, detailed analysis. However, these streams may be included as part of the *EXISTING CONDITIONS, ENVIRONMENTAL EFFECTS,* and *SPECIALIST RECOMMENDATIONS FOR SOUTH FORK LOST, CILLY, UNNAMED, AND SOUP CREEKS.*

## ANALYSIS METHODS AND SUBISSUES

The existing conditions of bull trout and westslope cutthroat trout populations and habitat will be described under *EXISTING CONDITIONS* of this analysis. *ENVIRONMENTAL (ALTERNATIVE) EFFECTS* will compare those existing conditions to the anticipated effects of the project alternatives to determine foreseeable impacts to bull trout and westslope cutthroat trout.

Analysis methods are a function of the types and quality of data available for analysis, which varies among the different watersheds in the project area. The analyses may either be quantitative or qualitative. The best available data for both populations and habitats will be presented separately for South Fork Lost, Cilly, Unnamed, and Soup creeks. Existing conditions and foreseeable environmental effects for South Fork Lost and Soup creeks will be explored using the following outline of subissues:

- Populations - Presence and Genetics
- Habitat - Flow Regimes
- Habitat - Sediment
- Habitat - Channel Forms
- Habitat - Riparian Function
- Habitat - Large Woody Debris
- Habitat - Stream Temperature
- Habitat - Connectivity
- Existing Collective Impacts and Cumulative Effects

Existing conditions and foreseeable environmental effects for Cilly and Unnamed creeks will be explored using a simplified set of accounts, which do include the more detailed outline of subissues. Where data is available regarding each subissue, that information will be described for Cilly and Unnamed creeks in the simplified accounts.

Existing road density and road stream-crossing density are other variables that have been indirectly correlated to native fisheries population trends across large regional areas (*Quigley and Arbelbide 1997*). The mechanisms through which road density and road stream-crossing density affect native fisheries populations include sedimentation, fishing access, poaching, recreational access, timber harvest access, and grazing and agriculture (*Quigley and Arbelbide 1997, Baxter et al 1999*). As road density and road stream-crossing density are, therefore, very broad surrogates of multiple potential actions, these variables are tools to describe potential cumulative effects to fisheries. In the absence of site-specific fisheries data to describe the existing conditions of the project area, road density and road stream-crossing density could be considered simple, viable measures of potential cumulative effects. However, the level of detailed, project-specific fisheries population and habitat data to be utilized throughout this analysis is expected to provide a much more accurate and precise baseline for the cumulative-effects analysis of fisheries in the project area. Therefore, road density and road stream-crossing density will not be used as a measure of potential cumulative effects in this analysis.

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## SUMMARY OF ALTERNATIVES

See *CHAPTER II - ALTERNATIVES* in the *DEIS and FEIS of THREE CREEKS TIMBER SALE PROJECT* for detailed information, specific mitigations, and road-management plans pertaining to No-Action Alternative A and Action Alternatives B, C, D, and E.

- ***No-Action Alternative A***

  Existing conditions relative to bull trout and westslope cutthroat trout in the project area would remain unchanged as a result of the selection of this alternative.

- ***Action Alternative B***

  Approximately 1,884 acres involving 34 proposed units would be harvested using various silviculture plans.

- ***Action Alternative C***

  Approximately 1,787 acres involving 33 proposed units would be harvested using various silviculture plans.

- ***Action Alternative D***

  Approximately 1,970 acres involving 33 proposed units would

be harvested using various silviculture plans.

- ***Action Alternative E***

  Approximately 1,999 acres involving 49 proposed units would be harvested using various silviculture plans.

Actions associated with Action Alternatives B, C, D, and E, including associated road construction and maintenance, would occur in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds, all of which provide varying degrees of bull trout and westslope cutthroat trout habitat.

## EXISTING CONDITIONS

A very low impact means that the impact is unlikely to be detectable or measurable, and the impact is not likely to be detrimental to the resource. A low impact means that the impact is likely to be detectable or measurable, but the impact is not likely to be detrimental to the resource. A moderate impact means that the impact is likely to be detectable or measurable, but the impact may or may not (50/50) be detrimental to the resource. A high impact means that the impact is likely to be detectable or measurable, and the impact is likely to be detrimental to the resource.

### ➢ *SOUTH FORK LOST CREEK*

South Fork Lost Creek is a third-order stream and the entire reach within the project area is considered fish-bearing.

#### ♦ South Fork Lost Creek Populations - Presence and Genetics

The South Fork Lost Creek watershed has been identified as a core habitat area within the Swan River drainage bull trout conservation area (*MBTSG 1996, MBTRT 2000*). Core areas are watersheds, including tributary drainages and adjoining uplands, used by migratory bull trout for spawning and early rearing, and by resident bull trout for all life history requirements (*MBTRT 2000*). Although bull trout may exhibit the resident life form in South Fork Lost Creek, this stream is used by bull trout primarily as spawning and rearing habitat for adfluvial populations associated with Swan Lake. South Fork Lost Creek supports westslope cutthroat trout exhibiting adfluvial, fluvial, and resident life forms.

Genetic data suggests that migratory bull trout adults in the upper Flathead River system have been found to frequently return to their natal or near-natal streams (*Kanda et al 1997*), and populations of migratory spawning bull trout in the Flathead River system have been observed returning to the same stream reaches during subsequent spawning runs (*Fraley and Shepard 1989*). This propensity for habitual adult migration to natal or near-natal streams and the consequent selection of unique spawning locations would make the use of redd counts in South Fork Lost Creek a useful measure of overall bull trout success in occupying this specific subbasin. Similarly, westslope cutthroat trout redd counts would be expected to express that species' overall success in occupying spawning and rearing habitats provided by South Fork Lost Creek.

The protocol for collecting redd count data in South Fork Lost Creek is described in *Weaver and Fraley (1991)*. Experienced crews and fixed survey reaches are used for result consistency.

*TABLE E-1 - BULL TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2005* shows that the

number of bull trout redds constructed in the South Fork Lost Creek reference reach has ranged from 9 to 47 during the years 1994 to 2005. The data is insufficient to describe a trend in bull trout redd counts with a high degree of certainty. An analysis of bull trout redd counts from throughout the Swan River drainage suggests that the larger bull trout population may be increasing (*Rieman and Myers 1997*), but the same study also indicates that a larger data set than that provided in this table is likely needed in order to begin identifying long-term trends of bull trout populations in individual streams. However, *Weaver (2005)* has indicated that the existing Swan River drainage bull trout population appears to be stable, and redd counts from South Fork Lost and Soup creeks are generally representative of trends in other bull trout spawning streams within the drainage. *Weaver (2005)* noted that increases in bull trout redd counts from 1996 through 2000 may have been due to a strong bull trout population response to *Mysis* shrimp densities in Swan Lake. (*Mysis* is an introduced macroinvertebrate to Swan Lake that has contributed to the food base of adfluvial bull trout and westslope cutthroat trout.)

*TABLE E-2 - WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2004* shows that the number of westslope cutthroat trout redds constructed in the South Fork Lost Creek reference reach has ranged from 7 to 26 during the years 1994 to 2004. Although the data is insufficient to describe a trend in westslope cutthroat trout redd counts with a high degree of certainty, this data is likely indicative of a generally stable westslope cutthroat trout population associated with the South Fork Lost Creek drainage.

*Leathe et al (1985)* describes bull trout and westslope cutthroat trout population densities in 2 different reaches of South Fork Lost Creek as ranging from low to moderate (see *TABLE E-3 - SPECIES DENSITIES IN SOUTH FORK LOST CREEK, 1982 THROUGH 1983 [LEATHE*

***TABLE E-1 - BULL TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2005***

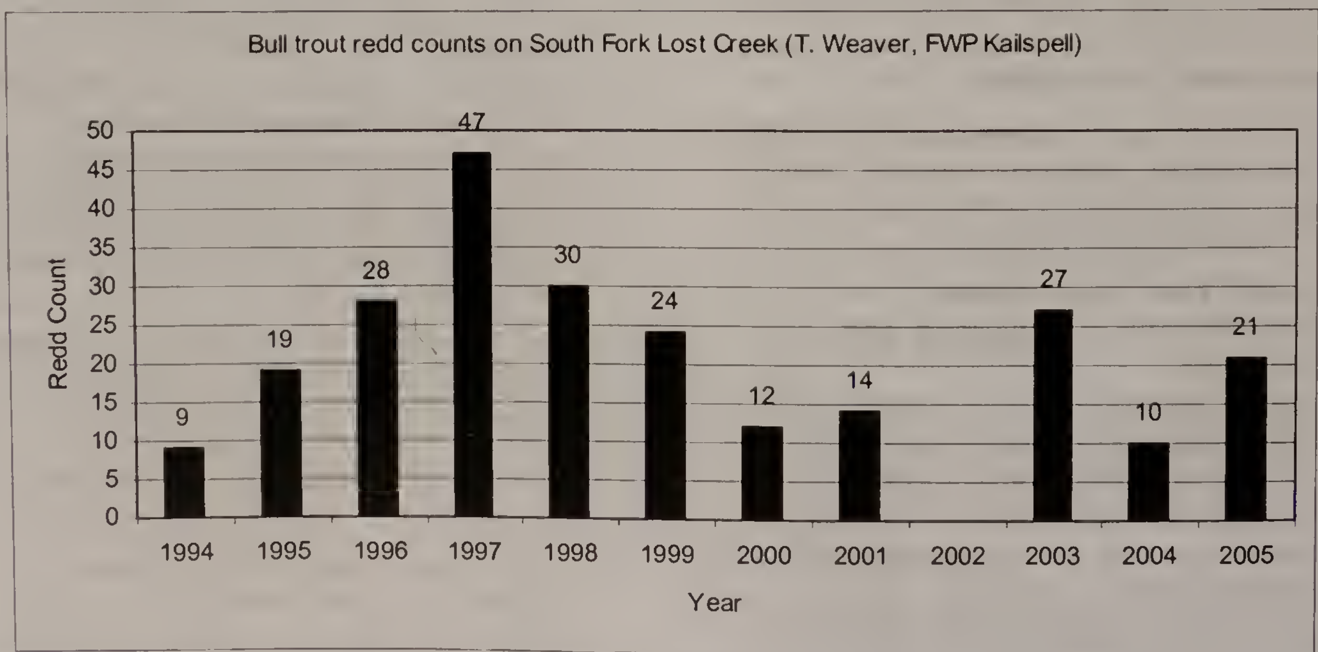


*TABLE E-2 - WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUTH FORK LOST CREEK, 1994 THROUGH 2004*

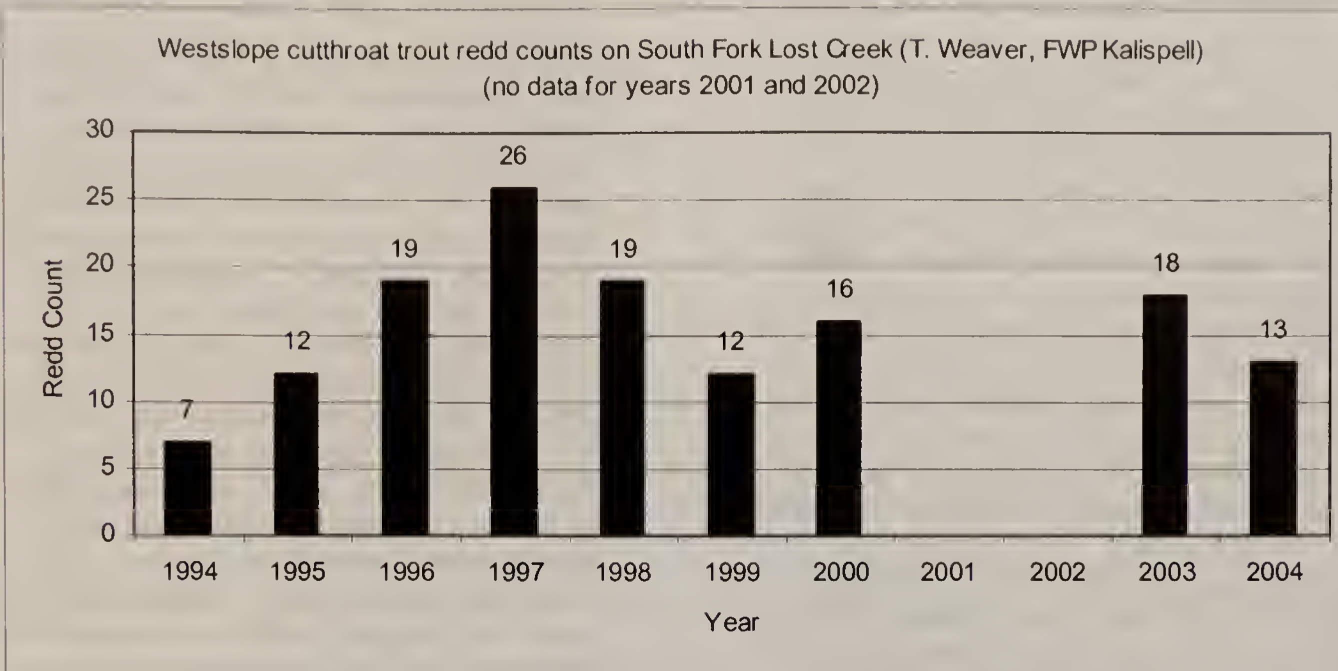



*TABLE E-3 - SPECIES DENSITIES IN SOUTH FORK LOST CREEK, 1982 THROUGH 1983 (LEATHE ET AL 1985)*

| | NUMBER OF FISH GREATER THAN 75 MILLIMETERS PER 300 METERS | | | NUMBER OF FISH GREATER THAN 150MILLIMETERS PER 300 METERS | | |
|---|---|---|---|---|---|---|
| REACH/YEAR SURVEYED | BULL TROUT | WESTSLOPE CUTTHROAT TROUT | EASTERN BROOK TROUT | BULL TROUT | WESTSLOPE CUTTHROAT TROUT | EASTERN BROOK TROUT |
| 1/1983 | 24 ('low') | 36 ('low') | 93 ('mod') | 5 ('low') | 16 ('low') | 11 ('low') |
| 2/1982 | 99 ('mod') | 23 ('low') | 0 | 12 ('low') | 12 ('low') | 0 |

*ET AL 1985]).* Reach 1 starts at the confluence of North Fork Lost and South Fork Lost creeks and extends upstream to river mile 1.86. Reach 2 includes that portion of South Fork Lost Creek from river miles 1.86 to 6.21.

Independent of current population status, present are considerable existing and future risks to both bull trout and westslope cutthroat trout populations and genetics in South Fork Lost Creek and throughout the Swan River drainage. Perhaps the greatest future threats to bull trout in the Swan River drainage are from the introduction and spread of nonnative fish (*MBTSG 1996*). The recently confirmed introduction and reproduction of lake trout (*Salvelinus namaycush*) in Swan Lake is expected to have some level of acute negative effect to bull trout within the Swan River drainage. Lake trout will likely have a negative affect on bull trout populations in Swan Lake through the predation of juvenile and subadult life stages and niche displacement. These foreseeable interactions will likely be expressed through lower rates of bull trout redd count construction in South Fork Lost Creek.

Bull trout are also negatively affected by nonnative eastern brook trout primarily through hybridization and, to some extent, by the displacement of juvenile fish in rearing habitats. Data suggests that

bull trout and eastern brook trout hybridization has occurred throughout the Swan River drainage (*Kanda et al 1997*). Although samples from South Fork Lost Creek in 1993 (*MFISH 2005*) show that 100-percent genetically pure bull trout may exist in the stream, that particular sample set may not have conclusively ruled out hybridization in South Fork Lost Creek at that time (*Kanda et al 1997*). *Weaver (2005)* has noted that bull trout x eastern brook trout hybrids are occasionally captured during sampling efforts in South Fork Lost Creek. Several factors point toward hybridization as a lower overall risk to bull trout than that of displacement by lake trout: migratory bull trout tend to have a reproductive size advantage over resident eastern brook trout (*Rieman and McIntyre 1993*), and offspring can have a considerable chance of being sterile or exhibiting other progressive growth problems (*Leary et al 1983*).

Westslope cutthroat trout also face considerable threats from the introduction and spread of nonnative fish. Introgression from hybridization with rainbow trout (*Oncorhynchus mykiss*) and other cutthroat trout subspecies may pose the foremost risk to westslope cutthroat trout in Montana (*Liknes and Graham 1988*). Westslope cutthroat trout within South Fork Lost Creek below migration-barrier falls at river mile 4.94 are known to exhibit levels of genetic purity between 75 and 90 percent (*NRIS 2004*). Westslope cutthroat trout upstream of the migration barrier falls are potentially 100-percent genetically pure (*NRIS 2004*). Westslope cutthroat trout are susceptible to displacement by introduced salmonids, especially eastern brook trout; however, the variable mechanisms through which this occurs are not well understood (*Griffith 1988*).

Existing impacts to bull trout and westslope cutthroat trout populations and genetics in South Fork Lost Creek are due primarily to the introduction of nonnative salmonids. Existing impacts to bull trout in South Fork Lost Creek include an imminent moderate to high impact due to the propagation of lake trout in the drainage and a low to moderate impact due to hybridization with eastern brook trout. Existing impacts to westslope cutthroat trout include a moderate impact due to introgression from rainbow trout hybridization and a low to moderate impact from displacement by eastern brook trout (where the 2 species' distributions overlap below the migration-barrier falls).

- **South Fork Lost Creek Habitat – Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS* .) The analysis of hydrologic data for South Fork Lost Creek indicates that the existing average departure in flow regime is approximately 1.2 percent above the range of naturally occurring conditions (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest-crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates

that are similar to a mature forest).

Changes in flow regime can affect bull trout and westslope cutthroat trout fisheries through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish habitat variables. As a consequence, the likelihood is very low for very low existing direct and indirect impacts to these habitat characteristics as a result of the estimated 1.2-percent increase in flow regime to South Fork Lost Creek within the project area.

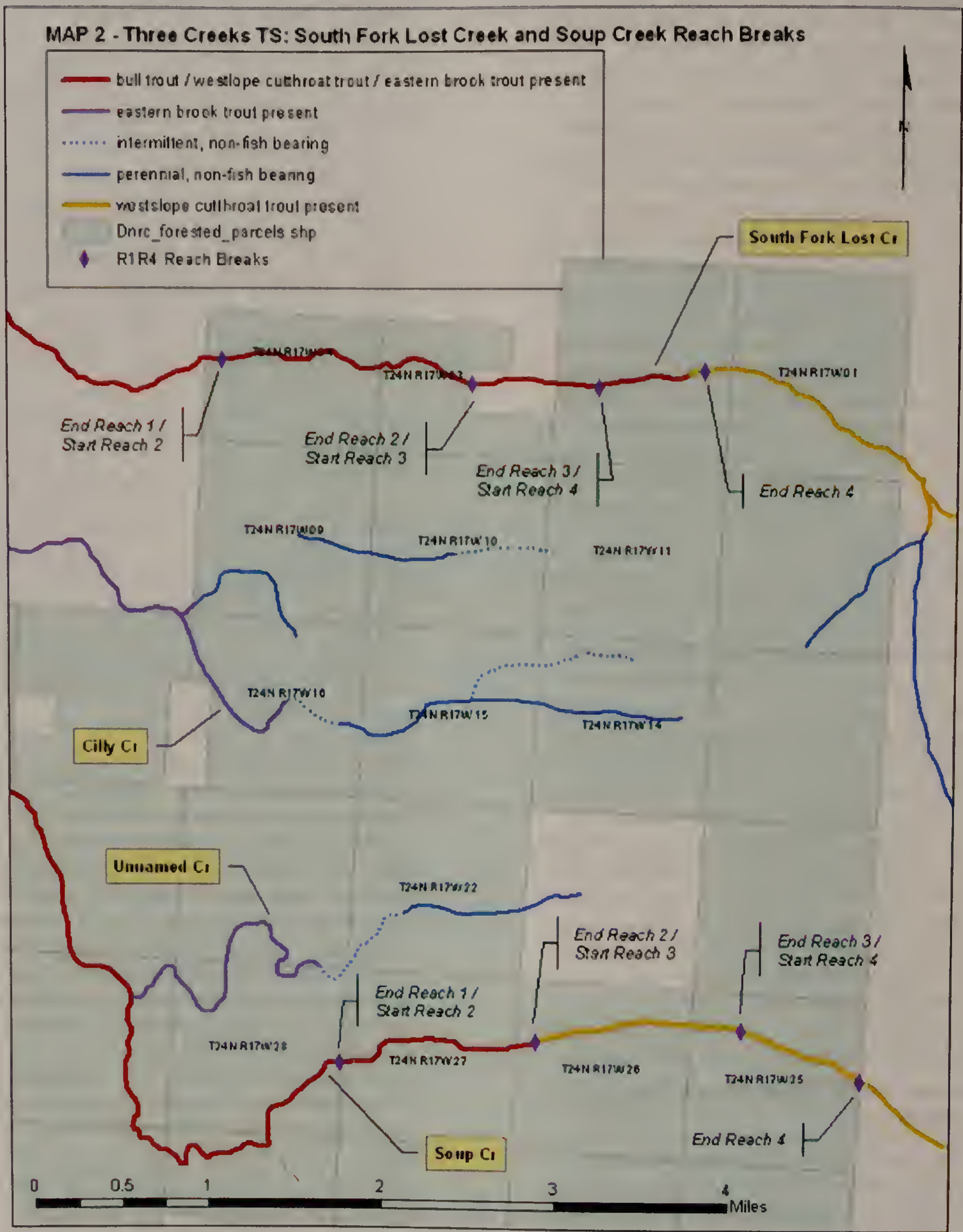
Changes in flow regime have been known to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, the likelihood is very low for very low existing direct and indirect impacts to native and nonnative fish species as a result of flow-regime modifications to South Fork Lost Creek within the project area.

- **South Fork Lost Creek Habitat - Sediment**

The existing stream-sediment processes of South Fork Lost Creek are described using the *Rosgen* stream morphological type, several different sediment composition surveys, and streambank stability. The stream morphology of 5 separate reaches of South Fork Lost Creek within the project area (see *FIGURE E-2 - SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEK TIMBER SALE PROJECT AREA*) is described using the *Rosgen* river classification (*Rosgen 1996*). From the confluence with North Fork Lost Creek (river mile 0.00) upstream to river mile 1.76 (Reach 1), the creek exhibits a 'C3' channel type; from river mile 1.76 to 3.42 (Reach 2), the creek exhibits a 'B3' channel type; from river mile 3.42 to 4.22 (Reach 3), the creek exhibits a 'C3' channel type; from river mile 4.22 to 4.94 (Reach 4), the creek exhibits a 'B3a' channel type; and from river mile 4.94 upstream to the USFS property boundary at river mile 6.27 (Reach 5), the creek exhibits a 'B3' channel type. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B3 morphological type is characteristic of channel compositions dominated by cobbles and codominated by boulders with lesser amounts of gravel and sand (*Rosgen 1996*). The C morphological type broadly includes meandering streams with both riffles and pools in low gradient, broad, alluvial valley bottoms (*Rosgen 1996*). More specifically, the C3 morphological type is indicative of cobble-dominated systems with well-developed floodplains.

Several surveys have been conducted to describe the sediment composition of South Fork Lost Creek, including *McNeil* core, substrate score, and *Wolman* pebble count. The *McNeil* core sampling methodology (*McNeil and Ahnell 1964*) has been demonstrated to be an

*FIGURE E-2 -SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA*



effective technique for measuring temporal changes in the streambed permeability of spawning gravels. *McNeil* core data has been collected in South Fork Lost Creek in a known bull trout spawning reach in the NE1/4SE1/4 of Section 3, T24N, R17W, between 1994 and 2005 (see *TABLE E-4 - MCNEIL CORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005*). *Weaver and Fraley (1991)* found that the percentage of substrates less than 6.35 millimeters in spawning beds was inversely proportional to bull trout and westslope cutthroat trout embryo survival in the Flathead River basin. The *Flathead Basin Commission (FBC)*, a cooperative program involving private, State, and Federal landowners in the river basin, subsequently determined that streams with spawning gravels having 35 or 40 percent of substrates less than 6.35 millimeters in any given year were "threatened" or "impaired", respectively, in regards to bull trout and westslope cutthroat trout embryo survival (*FBC 1991*). *McNeil* core sample results from South Fork Lost Creek are collected using *Weaver and Fraley (1991)* and displayed to show the proportion of substrates less than 6.35 millimeters in size. The sample sets show that the proportion of substrates less than 6.35 millimeters is under the 35-percent threshold for "threatened" status.

Embeddedness is generally described as the degree to which fine sediments surround coarse substrates on the streambed surface (*Sylte and Fischenich 2002*). The substrate score is one technique for measuring embeddedness, where higher scores indicate lower embeddedness and typically better juvenile bull trout habitat (*Shepard et al 1984*). A modified substrate score methodology (*Weaver and Fraley 1991 citing others*) has been employed on South Fork Lost Creek from 1994 through 2005 (see *TABLE E-5 - SUBSTRATE SCORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005*) in a

***TABLE E-4 - MCNEIL CORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005***

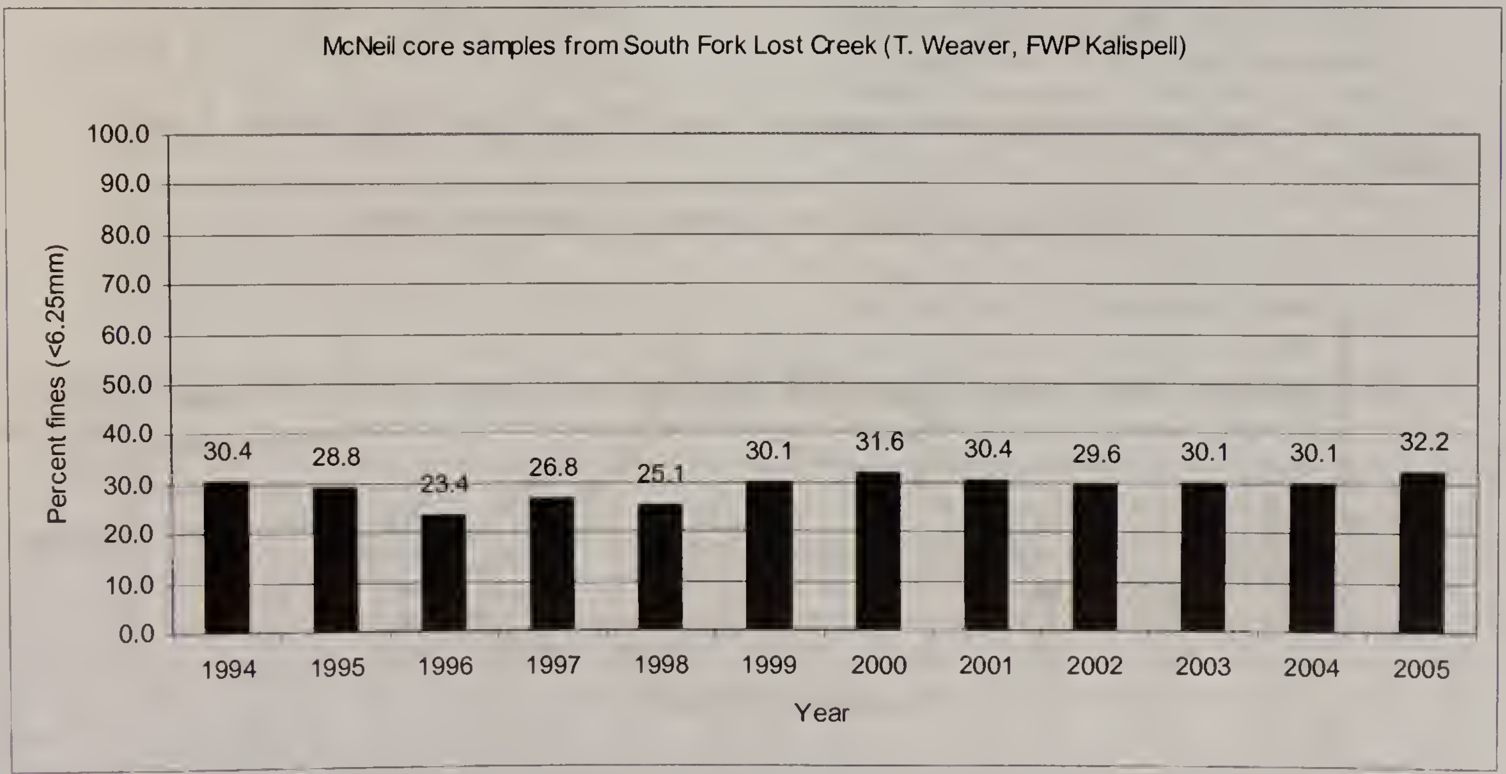
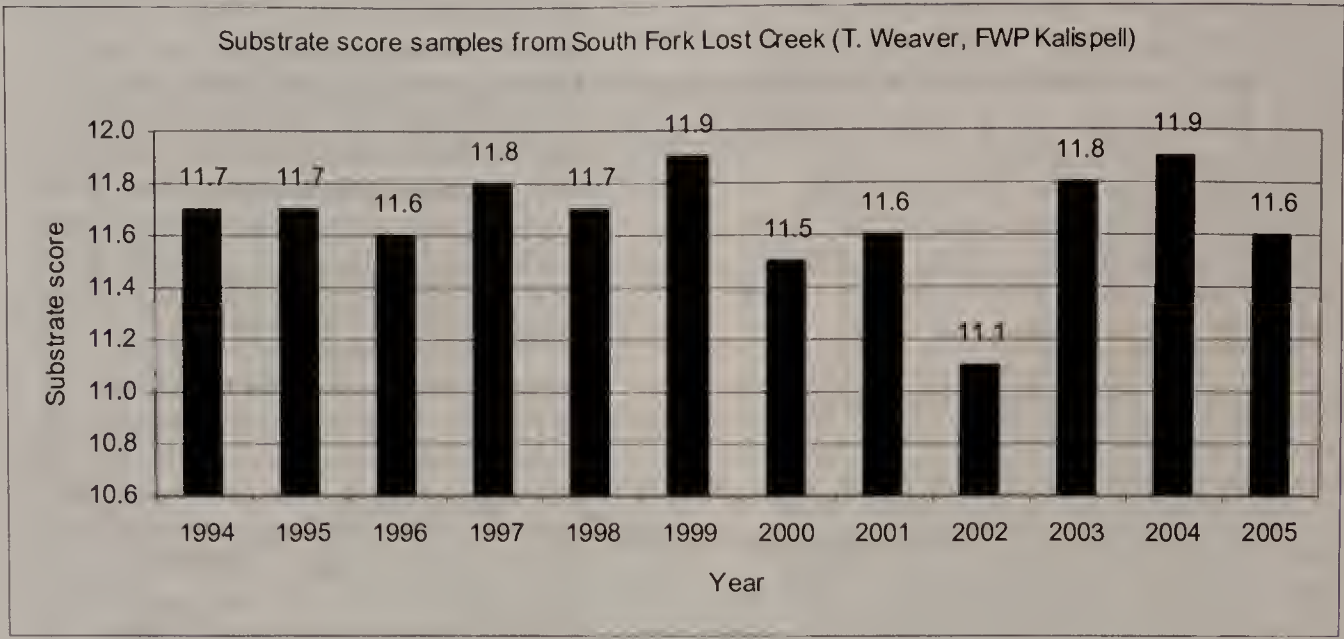


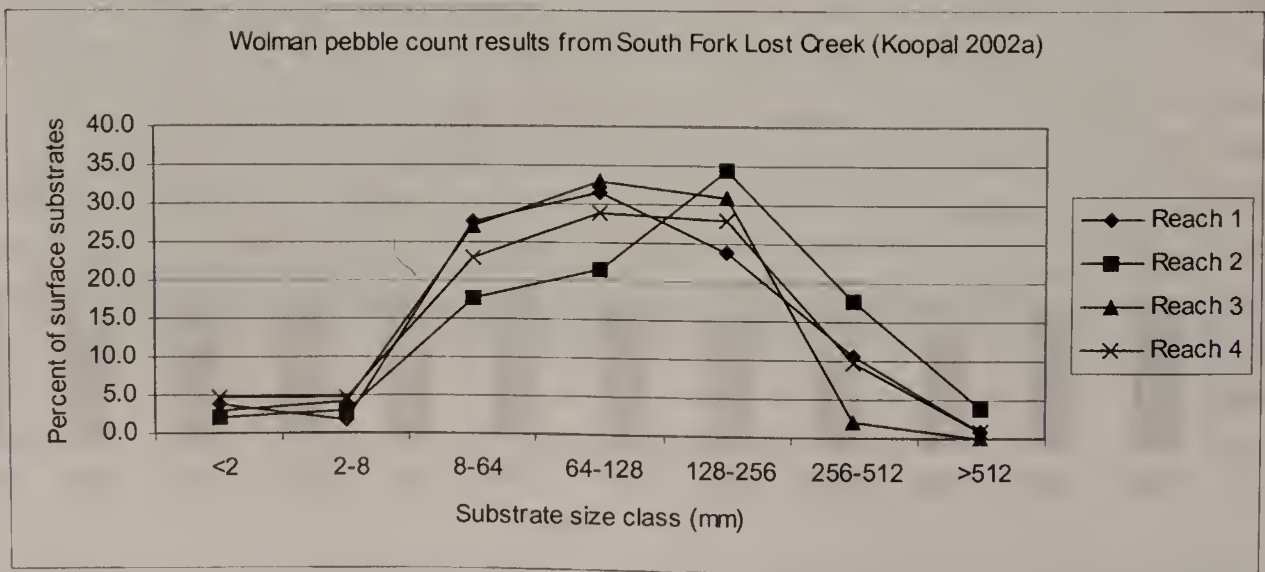
*TABLE E-5 - SUBSTRATE SCORE SAMPLES FROM SOUTH FORK LOST CREEK, 1994 THROUGH 2005*




known juvenile bull trout rearing reach (NW1/4SW1/4 of Section 4, T24N, R17W). The Flathead Basin Commission (FBC) has subsequently determined that streams with substrate scores less than 10 or 9 in any give year were "threatened" or "impaired", respectively, in regards to bull trout and westslope cutthroat trout embryo survival and juvenile rearing habitat (*FBC 1991*). The sample sets show substrate scores higher than 10, which indicate low levels of embeddedness.

The *Wolman* pebble count (*Wolman 1954*) is another method that can be used to describe temporal changes in substrate size classes on the streambed surface. Sample data from Reaches 1 through 4 on South Fork Lost Creek (see *FIGURE E-2 - SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA)* is available from 2002 (see *TABLE E-6 - WOLMAN PEBBLE COUNT RESULTS FROM SOUTH FORK LOST CREEK, 2002*). Considering Reaches 1 through 4, the maximum

*TABLE E-6 - WOLMAN PEBBLE COUNT RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002A)*



combined percentage of substrates less than 8 millimeters is 9.6 percent (Reach 4), which is considerably lower than the results calculated for the similar size class in the *McNeil* core samples (percentage of substrate less than 6.35 millimeters ranges from 23.4 percent to 31.6 percent). This difference suggests that there could be a greater level of interstitial spaces in the streambed surface (cobble) substrates than may be indicated by the *McNeil* core data.

The final assessment of stream-sediment processes includes a description of streambank stability. Streambank stability is a measure of bank erosion rates per stream length, and changes in the rates can be used as one indicator of potential existing impacts to fish habitats. Streambank stability data for South Fork Lost Creek is available for the year 2002 (see *TABLE E-7 – STREAMBANK STABILITY RESULTS FROM SOUTH FORK LOST CREEK [KOOPAL 2002A]*) and includes all stream habitats from the confluence with North Fork Lost Creek (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 4.94) (see *FIGURE E-2 – SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA*). The protocol used for collecting the streambank stability data is that outlined in *Overton et al (1997)*. Overall, the results of this data set show very high levels (98.61 to 100.00 percent) of streambank stability through Reaches 1 to 4 in the project area. Quantitative data of streambank stability is not available for Reach 5, but qualitative field reviews of the reach have also revealed very high levels of streambank stability.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the South Fork Lost Creek drainage are considered an unspecified, collective effect. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of *EXISTING CONDITIONS* in this analysis.)

*McNeil* core data indicates that the substrates of known spawning reaches are not "threatened", substrate scores describing streambed substrate embeddedness also indicate that known bull trout rearing habitat is not "threatened", and Wolman pebble counts suggest that high levels of streambed substrates are in the gravel, cobble, and boulder classes. Additionally, a recent streambank-stability assessment shows very low levels of potential streambank erosion, a

***TABLE E-7 – STREAMBANK STABILITY RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002A)***

| REACH | BANK LENGTH (FEET) | | PERCENT STABLE BANK | PERCENT UNSTABLE BANK | PERCENT UNDERCUT BANK |
|---|---|---|---|---|---|
| | LEFT | RIGHT | MEAN | MEAN | MEAN |
| 1 | 9,355.0 | 9,346.0 | 99.89 | 0.11 | 2.13 |
| 2 | 8,794.0 | 9,164.0 | 100.00 | 0.00 | 1.36 |
| 3 | 4,232.0 | 4,229.0 | 98.61 | 1.39 | 2.05 |
| 4 | 3,888.0 | 3,892.0 | 100.00 | 0.00 | 0.84 |

natural source of sedimentation. Based on these observations, no direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat likely exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Channel Forms**

Two descriptions of channel formation will also be used to describe existing bull trout and westslope cutthroat trout habitat in South Fork Lost Creek: *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory (Overton et al 1997)*. The stream gradient of Reaches 1 and 3 (see *FIGURE E-2 - SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA*) primarily ranges from 1 to 3 percent, and the stream gradient of Reaches 2 and 4 primarily ranges from 3 to 7 percent. The stream formations of South Fork Lost Creek are broadly described as exhibiting 'forced pool-riffle', 'forced step-pool', and 'plane bed' *Montgomery/ Buffington* classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). 'Forced step-pool' channel forms are also generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:1 to 1:4 and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*).

The *R1/R4 Fish Habitat Standard Inventory* is a useful protocol for describing detailed existing conditions and tracking temporal changes in the relative proportions of different stream microhabitats used by bull trout, westslope cutthroat trout, and other native fisheries. Inventory data for South Fork Lost Creek is available for the year 2002 (see *TABLE E-8 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUTH FORK LOST CREEK [KOOPAL 2002A]*) and includes all stream habitats from the confluence with North Fork Lost Creek (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 4.94) (see *FIGURE E-2 - SOUTH*

***TABLE E-8 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002A)***

| REACH | HABITAT TYPE | TOTAL NUMBER OF UNITS | MEAN HABITAT LENGTH (FEET) | MEAN WIDTH (FEET) | MEAN HABITAT DEPTH (FEET) | MEAN WIDTH/ DEPTH RATIO | MEAN HABITAT AREA (SQUARE FEET) | MEAN HABITAT VOLUME (CUBIC FEET) |
|---|---|---|---|---|---|---|---|---|
| 1 | Fast | 70 | 122.8 | 19.4 | 0.38 | 53.34 | 2,385.8 | 901.4 |
| 1 | Slow | 20 | 33.4 | 19.4 | 1.17 | 17.84 | 649.5 | 759.3 |
| 2 | Fast | 76 | 95.9 | 18.6 | 0.38 | 50.54 | 1,782.6 | 683.3 |
| 2 | Slow | 41 | 36.0 | 21.0 | 1.15 | 20.40 | 755.9 | 866.3 |
| 3 | Fast | 35 | 91.3 | 16.2 | 0.31 | 55.65 | 1,481.5 | 461.9 |
| 3 | Slow | 22 | 47.3 | 17.7 | 1.08 | 18.21 | 838.1 | 907.3 |
| 4 | Fast | 25 | 122.6 | 16.6 | 0.35 | 48.12 | 2,031.1 | 714.2 |
| 4 | Slow | 19 | 37.5 | 18.0 | 1.31 | 15.50 | 674.5 | 881.8 |

*FORK LOST CREEK AND SOUP CREEK REACH BREAKS IN THE THREE CREEKS TIMBER SALE PROJECT AREA]*). In order to simplify the description of existing conditions, detailed habitat data from Reaches 1 through 4 has been consolidated into fast and slow habitat types. Fast habitats include stream features such as cascades, high and low gradient riffles, runs, and glides. Slow habitats include dammed pools, lateral scour pools, midchannel scour pools, plunge pools, and step pools. Bull trout and westslope cutthroat trout utilize all of the habitat types with varying frequency throughout the different life stages, although long-term persistence within a stream by all life stages of each species is generally limited by the amount and frequency of different slow habitat types. Increasing amounts of different pool habitats are typically proportional to increasing levels of bull trout and westslope cutthroat trout stream habitat quality.

The following existing conditions can be deduced from the 2002 habitat inventory:

- The habitat data for Reach 1 indicates that 78 percent of all channel forms are fast-type habitat features, and the remaining 22 percent of all channel forms are slow-type habitat features; approximately 7 percent of the total reach area includes slow-type habitat features, and approximately 19 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 2 indicates that 65 percent of all channel forms are fast-type habitat features, and the remaining 35 percent of all channel forms are slow-type habitat features; approximately 19 percent of the total reach area includes slow-type habitat features, and approximately 41 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 3 indicates that 61 percent of all channel forms are fast-type habitat features, and the remaining 39 percent of all channel forms are slow-type habitat features; approximately 26 percent of the total reach area includes slow-type habitat features, and approximately 55 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 4 indicates that 57 percent of all channel forms are fast-type habitat features, and the remaining 43 percent of all channel forms are slow-type habitat features; approximately 20 percent of the total reach area includes slow-type habitat features, and approximately 48 percent of the total reach volume is in slow-type habitat features.

This information portrays Reach 1 as having a relatively low proportion of slow, or pool, habitat features, and Reaches 2 through 4 are described as having relatively higher proportions of pool-habitat features. It can also be inferred that Reaches 2 through 4 have relatively higher levels of channel complexity, in-stream cover, and potential wintering habitat. Considering reach gradients, valley location, and geomorphological processes, the observed proportions of habitat types for each reach are within the broad ranges of expected conditions.

No specific conclusions regarding trends in channel form can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing specific trends in channel forms, no direct and indirect impacts to the channel-form component of bull trout and westslope cutthroat trout habitat are apparent in South Fork Lost Creek.

- **South Fork Lost Creek Habitat - Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream nutrient inputs, and other variables (*Hansen et al 1995*). This section will consider the following important existing conditions of the riparian area: stand type, site potential tree height, and stream shading.

The predominant riparian stand type along South Fork Lost Creek within the project area is western red cedar/oak fern. Although western red cedar is typically the dominant species during late seral and climax stages, other species such as grand fir, Engelmann spruce, Douglas-fir, and western larch are also major components of the overstory (*Hansen et al 1995*). Furthermore, the riparian stand type as it relates to the associated geology and soils can be classified as exhibiting both SL2B and SL3B characteristics, which primarily occur adjacent to B and C channel types with stream gradients ranging from 1 to 12 percent (*Sirucek and Bachurski 1995*). Where the SL2B and SL3B riparian landtypes occur with the stand type described above, expected conditions are somewhat poorly drained sites with deep, weakly developed, gravely or bouldery, sandy loams or loams (*Sirucek and Bachurski 1995*).

Five riparian forest surveys in Section 3, T24N, R17W, assessed specific riparian stand conditions adjacent to South Fork Lost Creek. During the surveys, all trees (live and dead) with a dbh (4.5 feet above the ground) were recorded. Results of the surveys indicate that the quadratic mean diameter of riparian trees is 9.1 inches, the average number of trees per acre is 764, and the average basal area per acre is 346.0 square inches.

Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site potential tree height of dominant and co-dominant trees at 100 years (*ARM 36.11.425[5]*) is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest units in Section 3, T24N, R17W. The site potential tree height along riparian zones adjacent to the proposed harvest units is approximately 95 feet, and calculations of the measure are displayed in *TABLE E-9 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUTH FORK LOST CREEK*.

Riparian areas also provide stream shading, which contributes to the regulation of stream-temperature regimes by intercepting direct solar radiation to the stream channel. During winter seasons, riparian

*TABLE E-9 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUTH FORK LOST CREEK**

| SAMPLE | SPECIES | HEIGHT (FEET) | AGE (YEARS) | SITE INDEX (BEST FIT) | SITE POTENTIAL TREE HEIGHT @ 100 YEARS (FEET) | MEAN SITE POTENTIAL TREE HEIGHT @ 100 YEARS (FEET) | REFERENCE |
|---|---|---|---|---|---|---|---|
| 1 | Grand fir | 70 | 55 | 45 | 116 | | USFS RN-71 |
| 2 | Grand fir | 92 | 102 | 30 | 91 | | USFS RN-71 |
| 3 | Grand fir | 43 | 90 | 30 | 91 | | USFS RN-71 |
| 4 | Grand fir | 53 | 135 | 30 | 91 | | USFS RN-71 |
| 5 | Grand fir | 56 | 95 | 30 | 91 | | USFS RN-71 |
| 6 | Western red cedar | 87 | 95 | N/A** | 92** | | N/A** |
| | | | | | | 95 | |

**Samples were taken by DNRC personnel during July 2004 from random dominant and co-dominant trees with average growth at a distance of 50 feet from the bankfull slope break.*
***Western red cedar height relative to age is generally inconsistent, which does not lend well to reliable index curves for the species. The site potential tree height at 100 years for this sample was estimated.*

areas may also function to regulate stream temperatures by inhibiting temperature loss through evaporation, convection, or long-wave radiation from the stream (*Beschta et al 1987*). The degree to which a riparian area blocks direct solar radiation to the stream can be determined by measuring the angular canopy density, which is a function of riparian tree species composition, stand age, and tree density (*Beschta et al 1987*). Samples of angular canopy density were taken at 6 locations from the center of South Fork Lost Creek during 2004, and measurements were taken for the months of July and August (the months during which direct solar radiation has the greatest potential effect on stream-temperature regimes). Results of these measurements indicate that the existing riparian tree vegetation blocks an average of 65 percent of direct solar radiation during July and an average of 81 percent of direct solar radiation during August.

A past disturbance to the riparian area includes the construction and location of USFS Road 680, which lies north of South Fork Lost Creek through the project area. The majority of the road corridor lies outside of the area encompassed by the site potential tree height, but approximately 1,300 linear feet of the road corridor lies within 10 feet to 95 feet of the bankfull slope break of South Fork Lost Creek. Based on field estimates, the average distance between the road corridor and the bankfull slope break within the 1,300 linear foot zone is approximately 70 feet. As the road lies to the north of the stream, stream shading has likely been little affected; however, the road corridor is likely having a low existing impact through reduced recruitable large woody debris.

Other past disturbance in the riparian area includes the harvest of isolated western larch. Based on field observations, this past harvest of western larch occurred at least 30 years ago at a rate of approximately one tree per 200 linear feet.

Due to the location of the USFS Road 680 corridor, low direct

and indirect impacts to the riparian function component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat – Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation; this material is a critical component in the formation of complex habitat for bull trout and westslope cutthroat trout. All life stages of bull trout and westslope cutthroat trout have been observed closely associating with large woody debris in the Flathead River basin (*Pratt 1984, Shepard et al 1984*). Large-woody-debris recruitment rates to South Fork Lost Creek throughout the project area can be described using large-woody-debris counts per stream length, and this data was collected during 2002 as part a *R1/R4 Fish Habitat Standard Inventory (Overton et al 1997)* (see *TABLE E-10 – LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUTH FORK LOST CREEK [KOOPAL 2002])*. Large-woody-debris counts for South Fork Lost Creek include all stream habitats from the confluence with North Fork Lost Creek (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 4.94).

Data from reference reaches (*Harrelson et al 1994*) throughout the Flathead River basin region indicate that the expected frequency of large woody debris in undisturbed B channels ranges from 74 to 172 pieces per 1,000 feet (*Bower 2006*). This data suggests that the existing frequencies of large woody debris in Reaches 2 and 4 of South Fork Lost Creek are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics. Likewise, data indicates that the expected frequency of large woody debris in undisturbed C channels in the region ranges from 1 to 121 pieces per 1,000 feet (*Bower 2006*). This data suggests that the existing frequencies of large woody debris in Reaches 1 and 3 of South Fork Lost Creek are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics.

No apparent direct and indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

***TABLE E-10 – LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUTH FORK LOST CREEK (KOOPAL 2002)***

| | **REACH** | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| Channel type | C | B | C | B |
| Total reach length (feet) | 9,264 | 8,763 | 4,238 | 3,778 |
| Total number of single pieces | 99 | 106 | 48 | 36 |
| Total number of pieces in aggregates | 458 | 696 | 289 | 334 |
| Total number of root wads | 20 | 23 | 10 | 14 |
| Total pieces of large woody debris in reach | 577 | 825 | 347 | 384 |
| Number of pieces per 1,000 feet | 62 | 94 | 82 | 102 |

- **South Fork Lost Creek Habitat - Stream Temperature**

Stream-temperature data for South Fork Lost Creek is available for 2001, 2003, 2004, and 2005 and is displayed in *TABLE E-11 - STREAM-TEMPERATURE DATA FOR SOUTH FORK LOST CREEK. FIGURE E-3 - THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM-TEMPERATURE LOGGERS* displays the locations of stream-temperature data recorders on South Fork Lost Creek.

Stream-temperature data indicates that the annual maximum weekly maximum temperature at the water-quality sample site has ranged from 11.5 to 12.7 degrees Celsius for the years 2001, 2003, 2004, and 2005. During these years the maximum seasonal temperature recorded at the water-quality sample site ranged from 11.7 to 12.9 degrees Celsius. For comparison, a maximum seasonal temperature of 12.2 degrees Celsius was recorded during 1983 approximately 1,000 feet downstream of the water-quality sample site (*Leathe et al 1985*), which suggests that maximum seasonal temperatures in the vicinity of this location of South Fork Lost Creek may not have been markedly variable during the past 2 decades.

Rates of change in stream temperature are typically variable between different stream segments, as rates of change in stream temperature are generally a function of variations in stream shading, aspect, stream volume, net radiation, evaporation, convection, conduction, groundwater interactions, and inputs from tributaries (*Beschta et al 1987*). During 2004, the rate of change in maximum weekly maximum stream temperature between SFKLost#3 and SFKLost#2 is approximately -0.5 degrees Celsius per half mile, +0.2 degrees Celsius per half mile between SFKLost#2 and SFKLost#1, and +0.4 degrees Celsius per half mile between SFKLost#1 and SFKLost_NWLO_WQsite. During 2005, the rate of change in maximum weekly maximum stream temperature between SFKLost#3 and SFKLost#2 is approximately -0.8 degrees Celsius per half mile, +0.2 degrees Celsius per half mile between SFKLost#2 and

***TABLE E-11 - STREAM-TEMPERATURE DATA FOR SOUTH FORK LOST CREEK****

| SITE NAME | MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS) | WARMEST DAY OF MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS) | | DAYS GREATER THAN | | |
|---|---|---|---|---|---|---|
| | | DATE | MAXIMUM | 10.0 | 15.0 | 21.1 |
| | | | | CELSIUS | | |
| SFKLost_NWLO_WQsite_2001 | 11.7 | 08/15/01 | 11.8 | 58 | 0 | 0 |
| SFKLost_NWLO_WQsite_2003 | 12.7 | 07/23/03 | 12.9 | 69 | 0 | 0 |
| SFKLost_NWLO_WQsite_2004 | 12.1 | 07/16/04 | 12.6 | 52 | 0 | 0 |
| SFKLost#1_Lower_2004 | 11.4 | 07/15/04 | 11.9 | 44 | 0 | 0 |
| SFKLost#2_Middle_2004 | 11.2 | 07/16/04 | 11.7 | 40 | 0 | 0 |
| SFKLost#3_Upper_2004 | 11.7 | 07/16/04 | 12.2 | 45 | 0 | 0 |
| SFKLost_NWLO_WQsite_2005 | 11.5 | 08/09/05 | 11.7 | 45 | 0 | 0 |
| SFKLost#1_Lower_2005 | 10.7 | 07/19/05 | 10.9 | 33 | 0 | 0 |
| SFKLost#2_Middle_2005 | 10.5 | 07/19/05 | 10.7 | 31 | 0 | 0 |
| SFKLost#3_Upper_2005 | 11.3 | 08/06/05 | 11.4 | 38 | 0 | 0 |

**Samples obtained by DNRC resource specialists using Water Temp Pro (Onset Corporation) data loggers.*

SFKLost#1, and +0.4 degrees Celsius per half mile between SFKLost#1 and SFKLost_NWLO_WQsite. It is highly likely that inputs from cooler groundwater influenced the stream-temperature regime between SFKLost#3 and SFKLost#2, where the maximum weekly maximum stream temperature dropped appreciably at the rate of approximately -0.5 degrees Celsius per half mile during 2004 and at the rate of approximately -0.8 degrees Celsius per half mile during 2005. Groundwater interactions are known to affect many of the streams in the Swan River valley (*Baxter 1997, Stanford and Ward 1993*), and the stream-temperature effects of groundwater interactions likely occur periodically in other reaches of South Fork Lost Creek. However, the extent to which different groundwater interactions affect stream temperatures is generally a function of a multitude of site-specific variables and not consistent across drainages.

In respect to bull trout, the temperature ranges described in *TABLE E-11 - STREAM-TEMPERATURE DATA FOR SOUTH FORK LOST CREEK* are within the species' tolerances as observed in various studies. *Fraley and Shepard (1989)* rarely observed juvenile bull trout in streams exceeding 15 degrees Celsius. *Gamett (2002)* did not find bull trout where maximum stream temperatures exceeded 20 degrees Celsius. *Reiman and Chandler (1999)* found that bull trout are most frequently observed in streams having summer maximum temperatures of approximately 13 to 14 degrees Celsius.

No apparent direct and indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek Habitat - Connectivity**

The project area has 2 bridge crossings over South Fork Lost Creek in the NW1/4SW1/4 of Section 4, and the NW1/4SE1/4 of Section 2, all in T24N, R17W. These crossings provide full passage of all life stages of bull trout and westslope cutthroat trout.

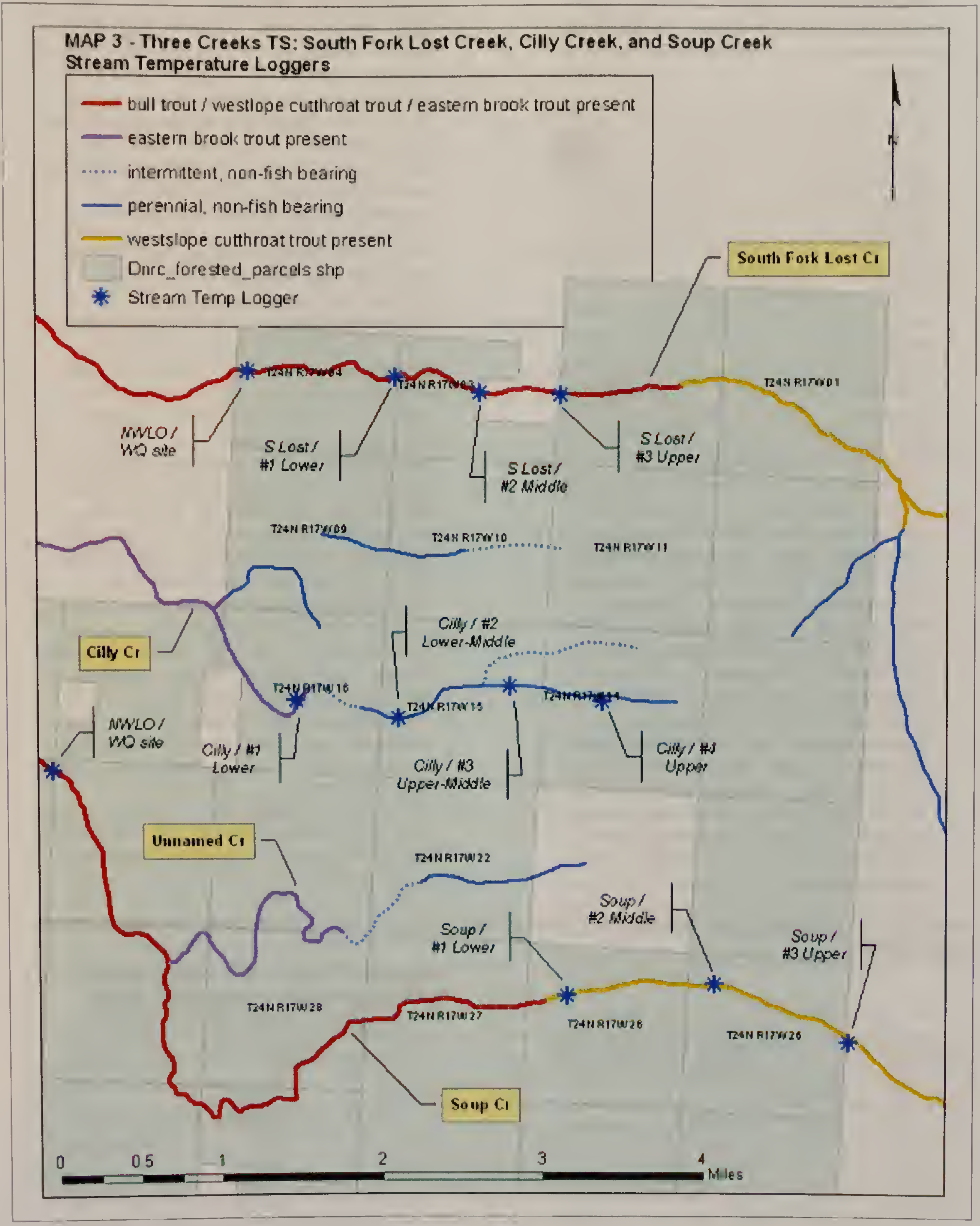
A set of naturally occurring waterfalls in the NW1/4SE1/4 of Section 2, T24N, R17W (river mile 4.94) pose complete migration barriers to bull trout and westslope cutthroat trout. Both bull trout and westslope cutthroat trout exist below the barriers, and only westslope cutthroat trout are known to exist upstream of the barriers.

Although the waterfall migration barriers limit bull trout and westslope cutthroat trout migration in South Fork Lost Creek, the stream features are naturally occurring and not considered an existing impact. No direct and indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat exist in South Fork Lost Creek.

- **South Fork Lost Creek - Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the South Fork Lost Creek portion of the project area, a matrix of

FIGURE E-3 - THREE CREEKS TIMBER SALE PROJECT: SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM-TEMPERATURE LOGGERS



existing effects to fisheries in the project area is displayed in *TABLE E-12 - MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUTH FORK LOST CREEK.*

One related action includes past and present construction on the road system construction in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The road system has been assessed for specific sources of sedimentation to streams in the South Fork Lost Creek watershed. Estimates indicate that approximately 19.8 tons per year of road material are contributed to streams in the South Fork Lost Creek watershed by the existing road system (see *WATERSHED AND HYDROLOGY ANALYSIS*). The collective effect from the existing road system, as represented by the estimated amount of material contributed to streams, likely represents an existing low to moderate impact to bull trout and westslope cutthroat trout in South Fork Lost Creek.

Other related actions that are considered in the existing collective impacts are a very low impact due to fishing and other related recreational uses, a low impact from past forest-management activities on upstream land ownerships, and a low impact from road and road stream-crossing construction and maintenance activities on upstream land ownerships.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, existing collective impacts to bull trout and westslope cutthroat trout in South Fork Lost Creek is likely moderate.

***TABLE E-12 - MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUTH FORK LOST CREEK***

| | **EXISTING IMPACTS TO BULL TROUT AND WESTSLOPE CUTTHROAT TROUT IN SOUTH FORK LOST CREEK** |
|---|---|
| Populations - presence and genetics | Low to high |
| Habitat - flow regimes | Very low |
| Habitat - sediment | None |
| Habitat - channel forms | None |
| Habitat - riparian function | Low |
| Habitat - large woody debris | None |
| Habitat - stream temperature | None |
| Habitat - connectivity | None |
| Other related actions | Very Low to moderate |
| *Existing collective impacts* | *Moderate* |

## ➢ *CILLY CREEK*

Cilly Creek is a second-order stream and only a very short reach within the project area is considered fish bearing.

- **Cilly Creek Populations – Presence and Genetics**

Eastern brook trout are the only fish inhabiting Cilly Creek within and adjacent to the project area. Although bull trout and westslope cutthroat trout likely inhabited Cilly Creek to some degree prior to an eastern brook trout invasion, several different surveys confirm that the native species no longer utilize the stream as habitat. A redd count survey during 1982 revealed no bull trout spawning in Cilly Creek (*Leathe et al 1985*). Another redd count survey during 1996 revealed no westslope cutthroat trout spawning in Cilly Creek (*T. Weaver, FWP Kalispell*). Electrofishing surveys of species presence during 1983 (*Leathe et al 1985*), 2004 (*T. Weaver, DFWP Kalispell*), and 2005 (*J. Bower, DNRC Missoula*) also confirmed that native species do not utilize Cilly Creek as habitat.

As eastern brook trout currently thrive in Cilly Creek, a presumption that bull trout and westslope cutthroat trout historically occupied the stream to some unknown degree is reasonable. The complete displacement by eastern brook trout, therefore, constitutes a high existing impact to bull trout and westslope cutthroat trout populations and genetics in Cilly Creek.

- **Cilly Creek Habitat – Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*.) The analysis of hydrologic data for Cilly Creek indicates that the existing average departure in flow regime is approximately 2.3 percent above the range of naturally occurring conditions (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

Changes in flow regime can affect fisheries through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish-habitat variables. As a consequence, a very low likelihood for very low direct and indirect impacts to these habitat characteristics exists as a result of the estimated 2.3-percent increase in flow regime to Cilly Creek within the project area.

Changes in flow regime have been known to affect fish spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, a

very low likelihood for very low direct and indirect impacts to native and nonnative fish species exists as a result of flow-regime modifications to Cilly Creek within the project area.

- **Cilly Creek Habitat - Sediment**

The stream morphology of the fish-bearing reach of Cilly Creek within the project area is described using the *Rosgen* river classification (*Rosgen 1996*). The fish-bearing reach of the stream exhibits a 'B4' channel type. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B4 morphological type is characteristic of channel compositions dominated by gravels (*Rosgen 1996*). As this condition appears consistent with those found in *Leathe et al (1985)*, the existing sediment characteristics of Cilly Creek are likely representative of historic trends. Furthermore, field surveys of the stream during 2004 and 2005 did not reveal channel or riparian disturbances that would otherwise point toward a deviation in the expected characteristics of sediment. No direct and indirect impacts to the sediment component of fish habitat likely exist in Cilly Creek.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the Cilly Creek drainage are considered an unspecified, collective effect. This broad variable is consequently addressed in the *Existing Collective Past and present Impacts* section of *EXISTING CONDITIONS* of this analysis.)

- **Cilly Creek Habitat - Channel Forms**

The description of channel formation used to describe existing fish habitat in Cilly Creek is the *Montgomery/ Buffington* classification (*Montgomery and Buffington 1997*). The stream gradient of the fish-bearing reach of Cilly Creek primarily ranges from 1 to 3 percent. The stream formations of the reach are broadly described as exhibiting the 'forced pool-riffle' and 'pool-riffle' *Montgomery/ Buffington* classification. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream. Both 'pool-riffle' channel forms typically exhibit pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). No direct or indirect impacts to the channel-form component of fish habitat are apparent in Cilly Creek.

- **Cilly Creek Habitat - Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream nutrient inputs, and other variables (*Hansen et al 1995*). This section will consider the following important existing conditions of the riparian area: site potential tree height and stream shading.

Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is equal to the height of the tallest trees

growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site potential tree height of dominant and co-dominant trees at 100 years (*ARM 36.11.425[5]*) is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest units in Section 16, T24N, R17W. The site potential tree height calculated by DNRC personnel during 2004 is 91 feet. The measure was calculated from 2 samples of grand fir adjacent to the fish-bearing reach.

Riparian areas also provide stream shading, which contributes to the regulation of stream-temperature regimes by intercepting direct solar radiation to the stream channel. During winter seasons, riparian areas may also function to regulate stream temperatures by inhibiting temperature loss through evaporation, convection, or long-wave radiation from the stream (*Beschta et al 1987*). The degree to which a riparian area blocks direct solar radiation to the stream can be determined by measuring the angular canopy density, which is a function of riparian tree species composition, stand age, and tree density (*Beschta et al 1987*). Samples of angular canopy density were taken at 6 different locations from the center of the fish-bearing reach of Cilly Creek during 2004, and measurements were taken for the months of July and August (the months during which direct solar radiation has the greatest potential effect on stream-temperature regimes). Results of these measurements indicate that the existing riparian tree vegetation blocks an average of 76 percent of direct solar radiation during July and an average of 83 percent during August.

Past disturbance in the riparian areas of Cilly Creek include the random, selective harvesting of large trees until approximately 30 years ago. The potential existing impacts are low since the result of the past associated action poses an existing low risk of reduced recruitable large woody debris over the foreseeable near future.

- **Cilly Creek Habitat – Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is an important component in the formation of habitat for fish. The frequency of existing large woody debris in the fish-bearing reach of Cilly Creek is likely consistent with the range of frequencies observed in other B channels on nearby South Fork Lost Creek and Soup Creek and described within this analysis. No direct and indirect impacts to the large-woody-debris component of fish habitat likely exist in Cilly Creek.

- **Cilly Creek Habitat – Stream Temperature**

Stream temperature data for Cilly Creek is available for 2004 and 2005 and is displayed in *TABLE E-13 - STREAM-TEMPERATURE DATA FOR CILLY CREEK*. *FIGURE E-3 - THREE CREEKS TIMBER SALE PROJECT: SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM-TEMPERATURE LOGGERS* displays the locations of stream-temperature data recorders on Cilly Creek.

Rates of change in stream temperature are typically variable between different stream segments, as rates of change in stream temperature are

TABLE E-13 - STREAM-TEMPERATURE DATA FOR CILLY CREEK*

| SITE NAME | MAXIMUM WEEKLY MEAN TEMPERATURE (CELSIUS) | WARMEST DAY OF MAXIMUM WEEKLY MEAN TEMPERATURE (CELSIUS) | | DAYS GREATER THAN | | |
|---|---|---|---|---|---|---|
| | | | | 10.0 | 15.0 | 21.1 |
| | | DATE | MAXIMUM | CELSIUS | | |
| Cilly#1_Lower_2004 | 7.5 | 08/13/04 | 7.6 | 0 | 0 | 0 |
| Cilly#2_Lower-Middle_2004 | 12.1 | 08/17/04 | 12.5 | 50 | 0 | 0 |
| Cilly#3_Upper-Middle_2004 | 10.6 | 08/17/04 | 10.8 | 34 | 0 | 0 |
| Cilly#4_Upper_2004 | 9.3 | 08/16/04 | 9.7 | 0 | 0 | 0 |
| Cilly#1_Lower_2005 | 7.9 | 06/21/05 | 8.7 | 0 | 0 | 0 |
| Cilly#2_Lower-Middle_2005 | 10.9 | 08/07/05 | 11.0 | 29 | 0 | 0 |
| Cilly#3_Upper-Middle_2005 | 10.4 | 08/09/05 | 10.5 | 13 | 0 | 0 |
| Cilly#4_Upper_2005 | 8.8 | 08/09/05 | 8.9 | 0 | 0 | 0 |

*Samples obtained by DNRC resource specialists using Water Temp Pro (Onset Corporation) data loggers.*

generally a function of variations in stream shading, aspect, stream volume, net radiation, evaporation, convection, conduction, groundwater interactions, and inputs from tributaries (*Beschta et al 1987*). During 2004, the rate of change in maximum weekly maximum stream temperature between Cilly#4 and Cilly#3 is approximately +1.1 degrees Celsius per half mile, +1.0 degrees Celsius per half mile between Cilly#3 and Cilly#2, and -3.2 degrees Celsius per half mile between Cilly#2 and Cilly#1. During 2005, the rate of change in maximum weekly maximum stream temperature between Cilly#4 and Cilly#3 is approximately +1.4 degrees Celsius per half mile, +0.3 degrees Celsius per half mile between Cilly#3 and Cilly#2, and -2.1 degrees Celsius per half mile between Cilly#2 and Cilly#1. It must be noted that between Cilly#2 and Cilly#1 field surveys have observed the stream losing all surface flows to subsurface flows during the period of seasonal maximum stream temperatures. It is, therefore, readily apparent that inputs from cooler groundwater influenced the stream-temperature regime between Cilly#2 and Cilly#1, where the maximum weekly maximum stream temperature dropped appreciably at the rate of approximately -3.2 degrees Celsius per half mile during 2004 and at the rate of approximately -2.1 degrees Celsius per half mile during 2005. Groundwater interactions are known to affect many of the streams in the Swan River valley (*Baxter 1997, Stanford and Ward 1993*), and the stream-temperature effects of groundwater interactions likely occur periodically in other reaches of Cilly Creek. However, the extent to which different groundwater interactions affect stream temperatures is generally a function of a multitude of site-specific variables and not consistent across drainages.

No direct and indirect impacts to the stream-temperature component of fish habitat are apparent in Cilly Creek.

- **Cilly Creek Habitat – Connectivity**

Cilly Creek has 1 bridge crossing in the project area located in the NW1/4SE1/4 of Section 7, T24N, R17W. The bridge crossing provides full passage of all life stages of eastern brook trout (and bull trout and westslope cutthroat

trout, if those species were present). Also, 3 culvert crossings of Cilly Creek are in the project area in the NW1/4SW1/4 of Section 8, the NW1/4NW1/4 and the NE1/4SW1/4 of Section 16, all in T24N, R17W. These 3 crossings provide full passage of most adult eastern brook trout (and most adult bull trout and westslope cutthroat trout, if those species were present). These crossings represent low direct and indirect impacts to the connectivity component of fish habitat existing in Cilly Creek.

- **Cilly Creek - Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the Cilly Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE E-14 - MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN CILLY* CREEK.

One related action includes past and present construction on the road system construction in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The existing road system has been assessed for specific sources of sedimentation to streams in the Cilly Creek watershed. Estimates indicate that approximately 2.9 tons per year of road material are contributed to streams in the Cilly Creek watershed by the existing road system (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*). The collective effect from the existing road system, as represented by the estimated amount of material contributed to streams, likely represents an existing low impact to fish in Cilly Creek.

Other related actions that are considered in the existing collective impacts are a very low impact due to fishing and other related recreational uses, a low impact from past forest-management activities on other land ownerships, and a low impact from road and road

***TABLE E-14 - MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN CILLY CREEK***

| | **EXISTING IMPACTS TO NATIVE AND NONNATIVE FISH IN SOUP CREEK** |
|---|---|
| Populations - presence and genetics | High |
| Habitat - flow regimes | Very Low |
| Habitat - sediment | None |
| Habitat - channel forms | None |
| Habitat - riparian function | Low |
| Habitat - large woody debris | None |
| Habitat - stream temperature | None |
| Habitat - connectivity | Low |
| Other related actions | Very low to low |
| *Existing collective impacts* | *High* |

stream-crossing construction and maintenance activities on other land ownerships.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, a moderate collective impact to bull trout and westslope cutthroat trout likely exists in Cilly Creek.

➢ ***UNNAMED CREEK***

Unnamed Creek is a second-order stream, and the fish-bearing reach of the stream is downstream of the project area.

- **Unnamed Creek Populations – Presence And Genetics**

Based on a thorough electrofishing survey of Unnamed Creek during 2005 (*J. Bower, DNRC Missoula*), eastern brook trout were determined to be the only fish inhabiting Unnamed Creek downstream from the project area. Measurements of relatively high stream temperatures (see *UNAMED CREEK HABITAT - STREAM TEMPERATURE*) likely indicate that the stream is a thermal barrier to bull trout and westslope cutthroat trout. Neither native species has likely ever utilized Unnamed Creek as habitat for any period of time. No direct and indirect impacts to bull trout and westslope cutthroat trout presence and genetics exist in Unnamed Creek.

- **Unnamed Creek Habitat – Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*.) The analysis of hydrologic data for Unnamed Creek indicates that the existing average departure in flow regime is approximately 0.5 percent above the range of naturally occurring conditions, which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

Changes in flow regime can affect fisheries through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish habitat variables. Consequently, the likelihood is very low for very low direct and indirect impacts to these habitat characteristics as a result of the estimated 0.5-percent increase in flow regime to Unnamed Creek downstream of the project area.

Major sections of the fish-bearing reach of Unnamed Creek seasonally dewater and exhibit intermittent flows.

Changes in flow regime have been known to affect fish spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, the likelihood is very low for very low direct and indirect impacts to nonnative fish species is very low as a result of flow-regime modifications to Unnamed Creek downstream of the project area.

- **Unnamed Creek Habitat – Sediment**

The stream morphology of the fish-bearing reach of Unnamed Creek downstream of the project area is described using the *Rosgen* river classification (*Rosgen 1996*). The fish-bearing reach of the stream alternates between 'B4', 'C4', and 'E5' channel types. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). The C morphological type broadly includes meandering streams with both riffles and pools in low-gradient, broad, alluvial valley bottoms (*Rosgen 1996*). The E morphological type broadly includes riffle-pool-dominated, low-gradient streams in broad alluvial valleys with well-developed floodplains (*Rosgen 1996*). Furthermore, the B4 and C4 morphological type is characteristic of channel compositions dominated by gravels, while the E5 morphological type is characteristic of channel compositions dominated by sands (*Rosgen 1996*). Several large beaver dam complexes exist within the 'E5' and 'C4' channel types. Field surveys of the stream during 2005 did not reveal channel or riparian disturbances that would otherwise point toward a deviation in the expected characteristics of sediment. No direct and indirect impacts to the sediment component of fish habitat likely exist in Unnamed Creek.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the Unnamed Creek drainage are considered an unspecified, collective effect. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of *EXISTING CONDITIONS* of this analysis.)

- **Unnamed Creek Habitat – Channel Forms**

The description of channel formation used to describe existing fish habitat in Unnamed Creek is the *Montgomery/ Buffington* classification (*Montgomery and Buffington 1997*). The stream gradient of the fish-bearing reach of Unnamed Creek primarily ranges from 1 to 4 percent. In those reaches of the stream that flow through forested areas, the stream formations are broadly described as exhibiting the 'forced pool-riffle' and 'pool-riffle' *Montgomery/Buffington* classification. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream. Both 'pool-riffle' channel forms typically exhibit pool frequencies of 1:5 to 1:7, where

the later ratio is channel width (*Montgomery and Buffington 1997*). In those reaches of the stream that flow through various sedge meadow complexes, the stream formations are broadly described as exhibiting the 'plane bed' *Montgomery/ Buffington* classification. The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*). Several large beaver dam complexes exist within the fish-bearing reach of Unnamed Creek. No direct and indirect impacts to the channel-form component of fish habitat are apparent in Unnamed Creek.

- **Unnamed Creek Habitat – Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream-nutrient inputs, and other variables (*Hansen et al 1995*). The proposed forest-management activities associated with each alternative are not expected to occur adjacent to the fish-bearing reach of Unnamed Creek. For this reason, a description of the existing condition of site potential tree height is not needed for the fisheries analysis.

Riparian areas also provide stream shading, which contributes to the regulation of stream-temperature regimes by intercepting direct solar radiation to the stream channel. Field surveys of the stream during 2005 did not reveal extraordinary riparian disturbances that would otherwise point toward a deviation in the expected range of stream-shade conditions.

However, past disturbance in the riparian areas of Unnamed Creek may include the random, selective harvesting of large trees up to approximately 30 years ago. This random, selective riparian harvesting likely represents a potential low-existing impact to nonnative fisheries in Unnamed Creek. A potential low impact exists since the result of the past associated action poses an existing low risk of reduced recruitable large woody debris over the foreseeable near future.

- **Unnamed Creek Habitat – Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is an important component in the formation of habitat for fish. The frequency of existing large woody debris in the fish-bearing reach of Unnamed Creek is likely consistent with the range of frequencies observed in other B and C channels on nearby South Fork Lost Creek and Soup Creek and is described within this analysis. In those reaches of the stream that flow through various sedge meadow complexes, field surveys did not reveal large woody debris as playing an important role in stream function. No direct and indirect impacts to the large-woody-debris component of fish habitat likely exist in Unnamed Creek.

- **Unnamed Creek Habitat – Stream Temperature**

Instantaneous daytime stream temperatures were recorded at 3 different locations of the fish-bearing reach of Unnamed Creek on June 23, 2005. The 3 measures were 15.5, 17.0, and

21.5 degrees Celsius. These daytime stream temperatures are relatively high for the month of June compared to other fish-bearing streams in the project area, and the stream temperatures during July and August are expected to be even greater. The simple measures from June 23, 2005 are likely indicative of a stream that presents a thermal barrier to bull trout and westslope cutthroat trout. Although these temperatures are relatively high, the field surveys of the stream during 2005 did not reveal extraordinary riparian disturbances or stream conditions that would otherwise point toward a deviation in the observed range of stream temperature. No apparent direct or indirect impacts to the stream-temperature component of fish habitat exist in Unnamed Creek.

- **Unnamed Creek Habitat – Connectivity**

Two culvert crossings of Unnamed Creek exist in the project area in the NE1/4NE1/4 of Section 29, T24N, R17W and the SW1/4NW1/4 of Section 28, T24N, R17W. The culvert crossing in Section 29 poses a migration barrier to eastern brook trout except for a portion of the strongest swimming adults. The culvert crossing in Section 28 poses a complete migration barrier to all life stages of eastern brook trout. The 2 culvert crossings represent an existing moderate to high direct and indirect impact to the connectivity component of fish habitat in Unnamed Creek.

- **Unnamed Creek – Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the Unnamed Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE E-15 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN UNNAMED CREEK.*

One related action includes past and present construction on the existing road system in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized

***TABLE E-15 – MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN UNNAMED CREEK***

| | **EXISTING IMPACTS TO NONNATIVE FISH IN UNNAMED CREEK** |
|---|---|
| Populations – presence and genetics | None |
| Habitat – flow regimes | Very Low |
| Habitat – sediment | None |
| Habitat – channel forms | None |
| Habitat – riparian function | Low |
| Habitat – large woody debris | None |
| Habitat – stream temperature | None |
| Habitat – connectivity | Moderate to high |
| Other related actions | Very low to low |
| *Existing collective impacts* | *Moderate* |

suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The existing road system has not been assessed for specific sources of sedimentation to streams in the Unnamed Creek watershed. However, the impacts in the Unnamed Creek watershed are likely similar to those found in Cilly Creek, since both watersheds are comparable in size, historic-management regimes, and past road development. The collective effect from the existing road system then likely represents an existing low impact to fish in Unnamed Creek.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, a moderate collective impact to bull trout and westslope cutthroat trout likely exists in Unnamed Creek.

### ➤ *SOUP CREEK*

Soup Creek is a third-order stream and the entire reach within the project area is considered fish-bearing.

- **Soup Creek Populations - Presence and Genetics**

The Soup Creek watershed has been identified as a core habitat area within the Swan River drainage bull trout conservation area (*MBTSG 1996, MBTRT 2000*). Core areas are watersheds, including tributary drainages and adjoining uplands, used by migratory bull trout for spawning and early rearing, and by resident bull trout for all life history requirements (*MBTRT 2000*). Although bull trout may exhibit the resident life form in Soup Creek, this stream is used by bull trout primarily as spawning and rearing habitat for adfluvial populations associated with Swan Lake. Soup Creek supports westslope cutthroat trout exhibiting adfluvial, fluvial, and resident life forms.

Genetic data suggests that migratory bull trout adults in the upper Flathead River system have been found to frequently return to their natal or near-natal streams (*Kanda et al 1997*), and populations of migratory spawning bull trout in the Flathead River system have been observed returning to the same stream reaches during subsequent spawning runs (*Fraley and Shepard 1989*). This propensity for habitual adult migration to natal or near-natal streams and the consequent selection of unique spawning locations would make the use of redd counts in Soup Creek a useful measure of overall bull trout success in occupying this specific subbasin. Similarly, westslope cutthroat trout redd counts would be expected to

express that species' overall success in occupying spawning and rearing habitats provided by Soup Creek.

The protocol for collecting redd-count data in South Fork Lost Creek is described in *Weaver and Fraley (1991)*. Experienced crews and fixed-survey reaches are used for result consistency.

The data in *TABLE E-16 - BULL TROUT REDD COUNTS IN SOUP CREEK, 1992 THROUGH 2005* shows the number of bull trout redds constructed in the Soup Creek reference reach has ranged from 2 to 12 during the years 1992 to 2004. This table contains insufficient data to describe a trend in bull trout redd counts with a high degree of certainty. An analysis of bull trout redd counts from throughout the Swan drainage suggests that the larger bull trout population may be increasing (*Rieman and Myers 1997*), but the same study also indicates that a larger data set than that provided in *TABLE E-16 - BULL TROUT REDD COUNTS IN SOUP CREEK, 1992 THROUGH 2005* is likely needed in order to begin identifying long-term trends of bull trout populations in individual streams. However, *Weaver (2005)* has indicated that the existing Swan River drainage bull trout population appears to be stable, and redd counts from South Fork Lost Creek and Soup Creek are generally representative of trends in other bull trout spawning streams within the drainage. *Weaver (2005)* noted that increases in bull trout redd counts from 1996 through 2000 may have been due to a strong bull trout population response to *Mysis* shrimp densities in Swan Lake. (*Mysis* is an introduced macroinvertebrate to Swan Lake that has contributed to the food base of adfluvial bull trout and westslope cutthroat trout.) The data in *TABLE E-17 - WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUP CREEK, 1994 THROUGH 2004* shows the number of westslope cutthroat trout redds constructed in the Soup Creek reference reach has ranged from 9 to 29 during the years 1994 through 2004. Although this table also has insufficient data to describe a trend in westslope cutthroat trout redd counts with a high

***TABLE E-16 - BULL TROUT REDD COUNTS IN SOUP CREEK, 1992 THROUGH 2005***

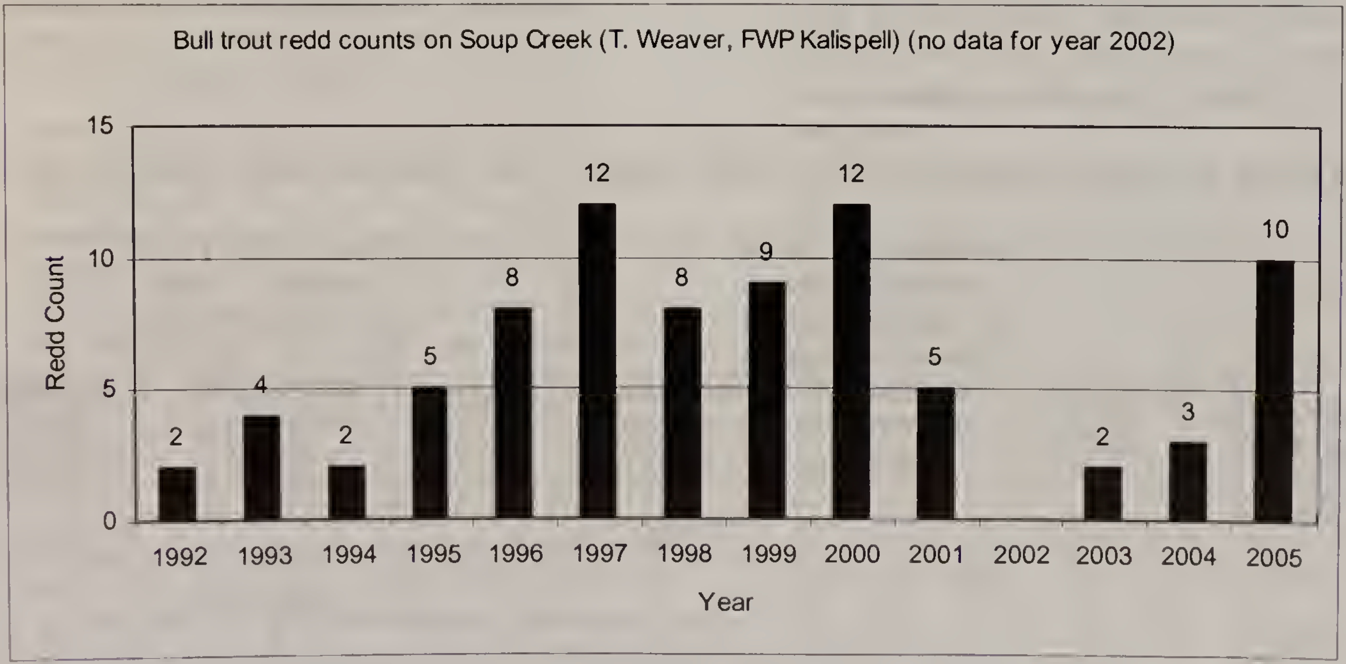
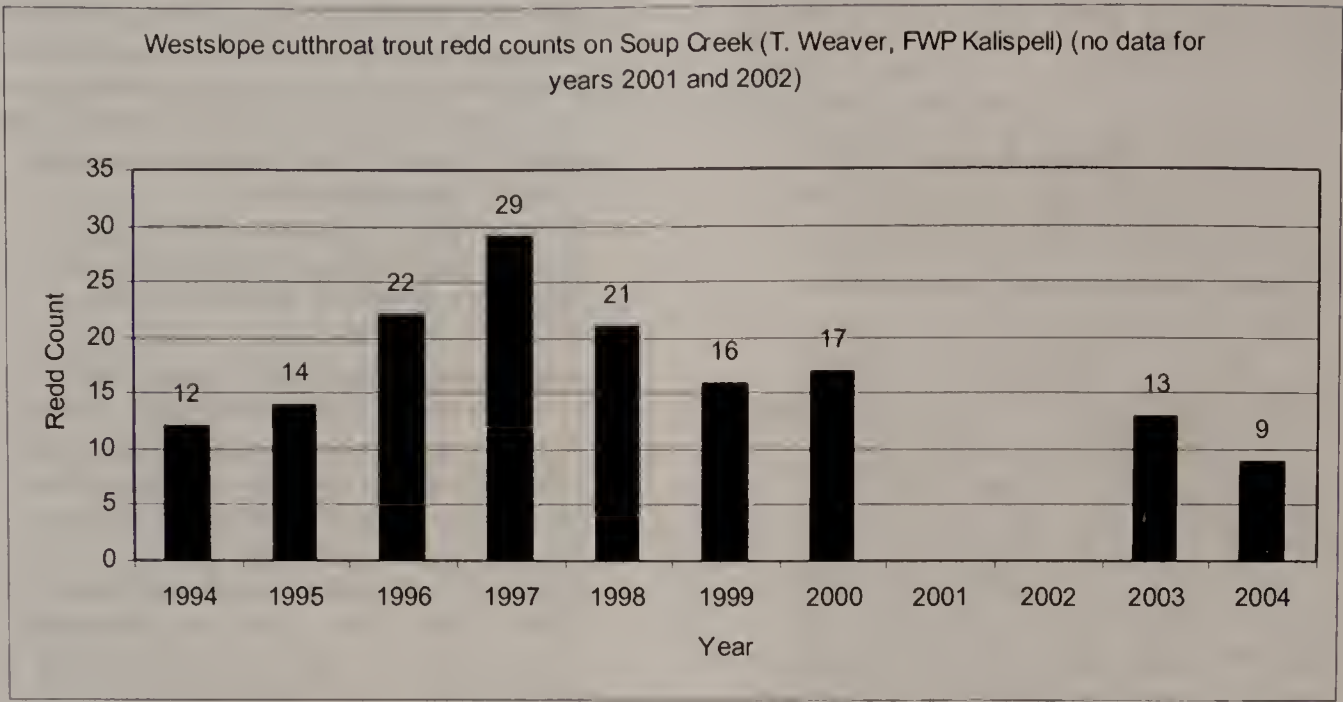


*TABLE E-17 - WESTSLOPE CUTTHROAT TROUT REDD COUNTS IN SOUP CREEK, 1994 THROUGH 2004*




degree of certainty, this data is likely indicative of a generally stable westslope cutthroat trout population associated with the Soup Creek drainage.

*Leathe et al (1985)* describes bull trout and westslope cutthroat trout population densities in 3 reaches of Soup Creek as ranging from low to high (see *TABLE E-18 - SPECIES DENSITIES IN SOUP CREEK, 1982 THROUGH 1983 [LEATHE ET AL 1985]*). Reach 1 starts at the confluence of Swan River and Soup Creek and extends upstream to river mile 6.34. Reach 2 includes that portion of Soup Creek from river mile 6.34 to 7.64, and Reach 3 extends from river mile 7.64 to 9.32.

Independent of current population status, there are considerable existing and future risks to both bull trout and westslope cutthroat trout populations and genetics in Soup Creek and throughout the Swan River drainage. Perhaps the greatest future threats to bull trout in the Swan River drainage are from the introduction and spread of nonnative fish (*MBTSG 1996*). The recently confirmed introduction and reproduction of

*TABLE E-18 - SPECIES DENSITIES IN SOUP CREEK, 1982 THROUGH 1983 (LEATHE ET AL 1985)*

| | NUMBER OF FISH GREATER THAN 75 MILLIMETERS PER 300 METERS | | | NUMBER OF FISH GREATER THAN 150 MILLIMETERS PER 300 METERS | | |
|---|---|---|---|---|---|---|
| REACH/YEAR SURVEYED | BULL TROUT | WESTSLOPE CUTTHROAT TROUT | EASTERN BROOK TROUT | BULL TROUT | WESTSLOPE CUTTHROAT TROUT | EASTERN BROOK TROUT |
| 1/1983 | 3 ('low') | 0 | 279 ('high') | 0 | 0 | 48 ('mod') |
| 2/1982 | 0 | 240 ('high') | 0 | 0 | 46 ('moderate') | 0 |
| 3/1983 | 0 | 0 | 0 | 0 | 0 | 0 |

lake trout (*Salvelinus namaycush*) in Swan Lake is expected to have some level of acute negative effect to bull trout within the Swan River drainage. Lake trout will likely have a negative affect on bull trout populations in Swan Lake through the predation of juvenile and subadult life stages and niche displacement. These foreseeable interactions will likely be expressed through lower rates of bull trout redd count construction in Soup Creek.

Bull trout are also negatively affected by nonnative eastern brook trout primarily through hybridization and, to some extent, by the displacement of juvenile fish in rearing habitats. Data suggests that bull trout and eastern brook trout hybridization has occurred throughout the Swan River drainage (*Kanda et al 1997*). Although several factors point toward hybridization as a lower overall risk to bull trout than that of displacement by lake trout: migratory bull trout tend to have a reproductive size advantage over resident eastern brook trout (*Rieman and McIntyre 1993*) and offspring can have a considerable chance of being sterile or exhibiting other progressive growth problems (*Leary et al 1983*).

Westslope cutthroat trout also face considerable threats from the introduction and spread of nonnative fish. Introgression from hybridization with rainbow trout (*Oncorhynchus mykiss*) and other cutthroat trout subspecies may pose the foremost risk to westslope cutthroat trout in Montana (*Liknes and Graham 1988*). Westslope cutthroat trout within Soup Creek below migration-barrier cascades at approximate river mile 7.50 are expected to express some level of introgression (*NRIS 2004*). Westslope cutthroat trout upstream of the migration barrier falls were determined to be 100 percent genetically pure from samples taken in 1983 (*MFISH 2005*). Westslope cutthroat trout are quite susceptible to displacement by introduced salmonids, especially eastern brook trout; however, the variable mechanisms through which this occurs are not well understood (*Griffith 1988*). Eastern brook trout are not known to exist upstream of the migration-barrier falls.

Existing impacts to bull trout and westslope cutthroat trout populations and genetics in Soup Creek are due primarily to the introduction of nonnative salmonids. Existing impacts to bull trout in Soup Creek include an imminent moderate to high impact due to the propagation of lake trout in the drainage and a low impact due to hybridization with eastern brook trout. Existing impacts to westslope cutthroat trout include a likely moderate impact due to introgression from rainbow trout hybridization and a moderate impact from displacement by eastern brook trout (where the 2 species' distributions overlap below the migration-barrier falls).

- **Soup Creek Habitat - Flow Regimes**

Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. (Flow regime is analogous to 'water yield' in *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*). The analysis of hydrologic data for Soup Creek indicates that the existing average departure in flow regime is approximately 1.0 percent above the range of naturally occurring conditions

(see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a 20- to 30-year-old forest (or, alternatively, a forest that exhibits evapotranspiration and precipitation interception rates that are similar to a mature forest).

Changes in flow regime can affect bull trout and westslope cutthroat trout fisheries through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. However, the existing levels of increased flow regime in the project area are generally not associated with detectable impacts to fish habitat variables. As a consequence, the likelihood is very low for very low existing direct and indirect impacts to these habitat characteristics as a result of the estimated 1.0-percent increase in flow regime to Soup Creek within the project area.

Changes in flow regime have been known to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival. Although, in general, the existing levels of increased flow regime described for the project area are not likely to have adverse impacts to fisheries spawning and embryo survival. For this reason, for the likelihood is very low for very low existing direct and indirect impacts to native and nonnative fish species as a result of flow-regime modifications to Soup Creek within the project area.

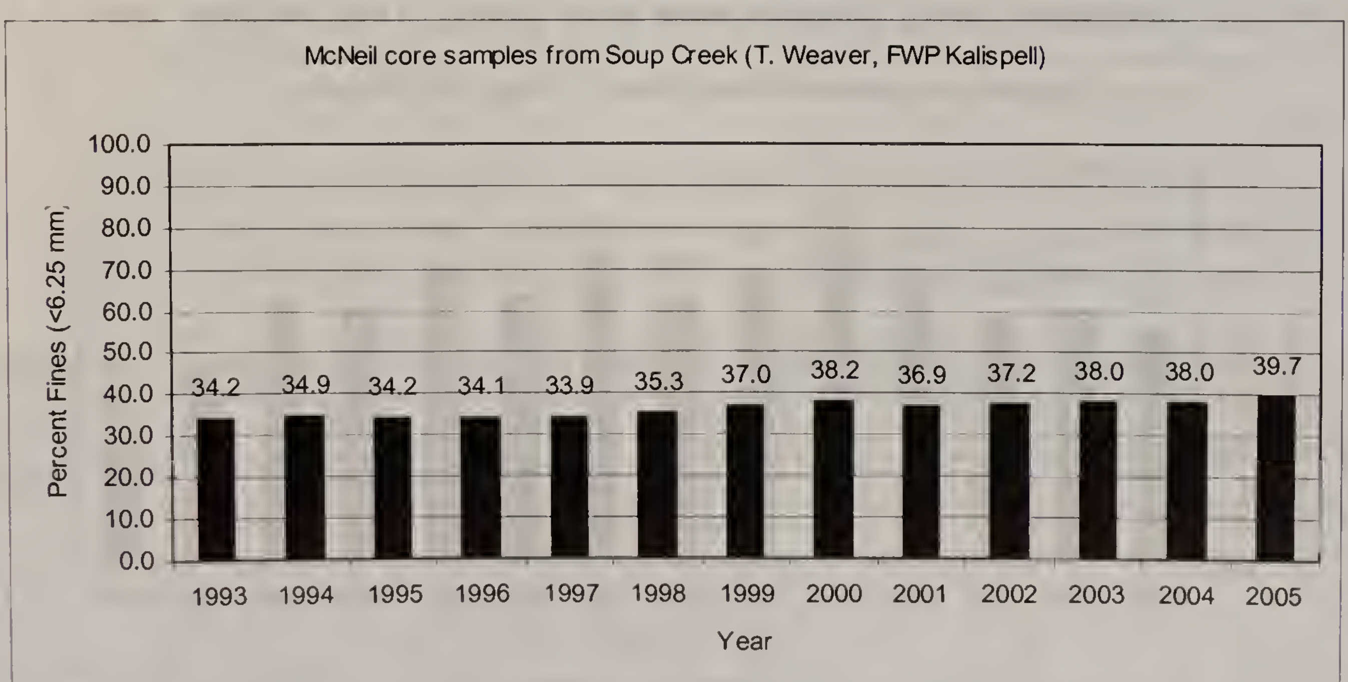
- **Soup Creek Habitat - Sediment**

Existing stream sediment processes that are described in this analysis are the *Rosgen* stream morphological type, sediment budget, and streambank stability. The stream morphology of 4 separate reaches of Soup Creek within the project area (see *FIGURE E-2 - THREE CREEKS TIMBER SALE PROJECT: SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) is described using the *Rosgen* river classification (*Rosgen 1996*). From the confluence with the Swan River (river mile 0.00) upstream to river mile 6.80 (Reach 1), the creek exhibits a 'C4' channel type; from river mile 6.80 to 7.45 (Reach 2), the creek exhibits a 'B3' channel type; from river mile 7.45 to 9.51 (Reach 3), the creek exhibits a 'A3' channel type; and from river mile 9.51 upstream to the Forest Service property boundary at river mile 10.37 (Reach 4), the creek exhibits a 'B4' channel type. The C morphological type broadly includes meandering streams with both riffles and pools in low gradient, broad, alluvial valley bottoms (*Rosgen 1996*). More specifically, the C3 morphological type is indicative of gravel-dominated systems with well-developed floodplains. The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B3 and B4 morphological types are characteristic of channel compositions dominated by cobbles and gravels, respectively (*Rosgen 1996*). The A3 morphological type includes streams with steep, entrenched, confined channels that are dominated by cobbles with lesser

amounts of boulders, gravel, and sand.

Several different surveys have been conducted to describe the sediment budget of Soup Creek, including *McNeil* core, substrate score, and *Wolman* pebble count. The *McNeil* core sampling methodology (*McNeil and Ahnell 1964*) has been demonstrated to be an effective technique for measuring temporal changes in the streambed permeability of spawning gravels. *McNeil* core data has been collected in Soup Creek in a known bull trout spawning reach (NE1/4NE1/4 of Section 19, T24N, R17W) between 1993 and 2005 (see *TABLE E-19 - MCNEIL CORE SAMPLES FROM SOUP CREEK, 1993 THROUGH 2005*). *Weaver and Fraley (1991)* found that the percentage of substrates less than 6.35 millimeters in spawning beds was inversely proportional to bull trout and westslope cutthroat trout embryo survival in the Flathead River basin. The FBC, a cooperative program involving private, State, and Federal landowners in the river basin, subsequently determined that streams with spawning gravels having 35 or 40 percent of substrates less than 6.35 millimeters in any give year were "threatened" or "impaired", respectively, in regards to bull trout and westslope cutthroat trout embryo survival *(FBC 1991)*. *McNeil* core sample results from Soup Creek are collected using *Weaver and Fraley (1991)* and displayed in *TABLE E-19 - MCNEIL CORE SAMPLES FROM SOUP CREEK, 1993 THROUGH 2005* to show the proportion of substrates less than 6.35 millimeters in size. Data from 1993 through 1997 shows that the proportion of substrates less than 6.35 millimeters is under the 35-percent threshold for "threatened" status. However, data from 1998 through 2005 indicates that the proportion of substrates less than 6.35 millimeters are over 35 percent, which indicates a "threatened" status in respect to bull trout and westslope cutthroat trout embryo survival. The data set from 1998 through 2005 may also indicate an increasing trend in the quantity of substrates less than 6.35 millimeters in size.

***TABLE E-19 - MCNEIL CORE SAMPLES FROM SOUP CREEK, 1993 THROUGH 2005***



Embeddedness is generally described as the degree to which fine sediments surround coarse substrates on the streambed surface (*Sylte and Fischenich 2002*). The substrate score is one technique for measuring embeddedness, where higher scores indicate lower embeddedness and typically better juvenile bull trout habitat (*Shepard et al 1984*). A modified substrate score methodology (*Weaver and Fraley 1991* citing others) has been employed on Soup Creek from 1992 through 2004 (see *TABLE E-20 - SUBSTRATE SCORE SAMPLES FROM SOUP CREEK, 1992 THROUGH 2005*) in a known juvenile bull trout rearing reach (NW1/4NW1/4 of Section 20, T24N, R17W). The FBC has subsequently determined that streams with substrate scores less than 10 or 9 in any given year were "threatened" or "impaired", respectively, in regards to juvenile bull trout rearing habitat (*FBC 1991*). All of the sample sets in this table show substrate scores higher than 10, except for 2004 and 2005. The scores of 9.8 in 2004 and 9.2 in 2005 are indicating a "threatened" status in respect to juvenile bull trout habitat quality for that year. The substrate score data from 1998 through 2005, which corresponds to those years when *McNeil* core readings have exceeded 35 percent, may also indicate a decreasing trend in substrate score, or conversely, increasing embeddedness due to fine substrates.

The *Wolman* pebble count (*Wolman 1954*) is another method that can be used to describe temporal changes in substrate size classes on the streambed surface. Sample data from Reaches 1 through 4 on Soup Creek (see *FIGURE E-2 - THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) is available from 2002 and 2004 (see *TABLE E-21 - WOLMAN PEBBLE COUNT RESULTS FROM SOUP CREEK, 2002 [REACHES 1 AND 2] AND 2004 [REACHES 3 AND 4]*). Within Reach 1, the combined percentage of substrates less than 8 millimeters is 54.1 percent. When this value is considered in conjunction with a *McNeil* core reading of 37.2 percent (*2002*), this indicates that fine substrates are well distributed on both the surface and subsurface of the streambed

***TABLE E-20 - SUBSTRATE SCORE SAMPLES FROM SOUP CREEK, 1992 THROUGH 2005***

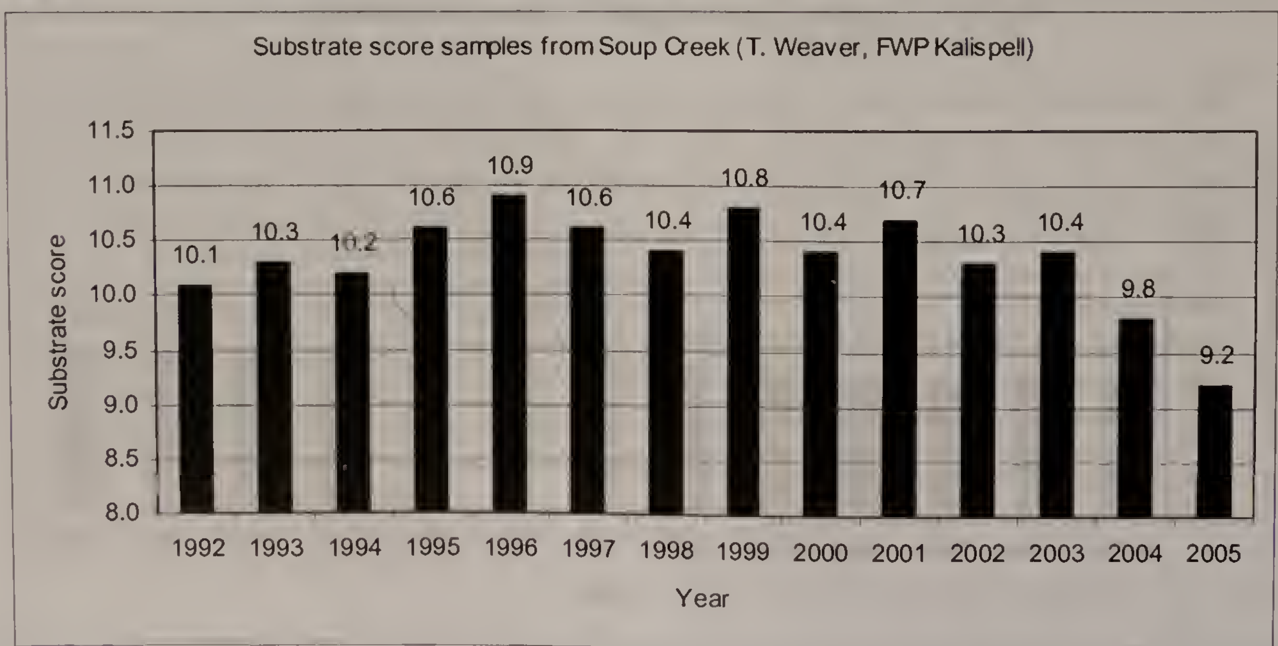
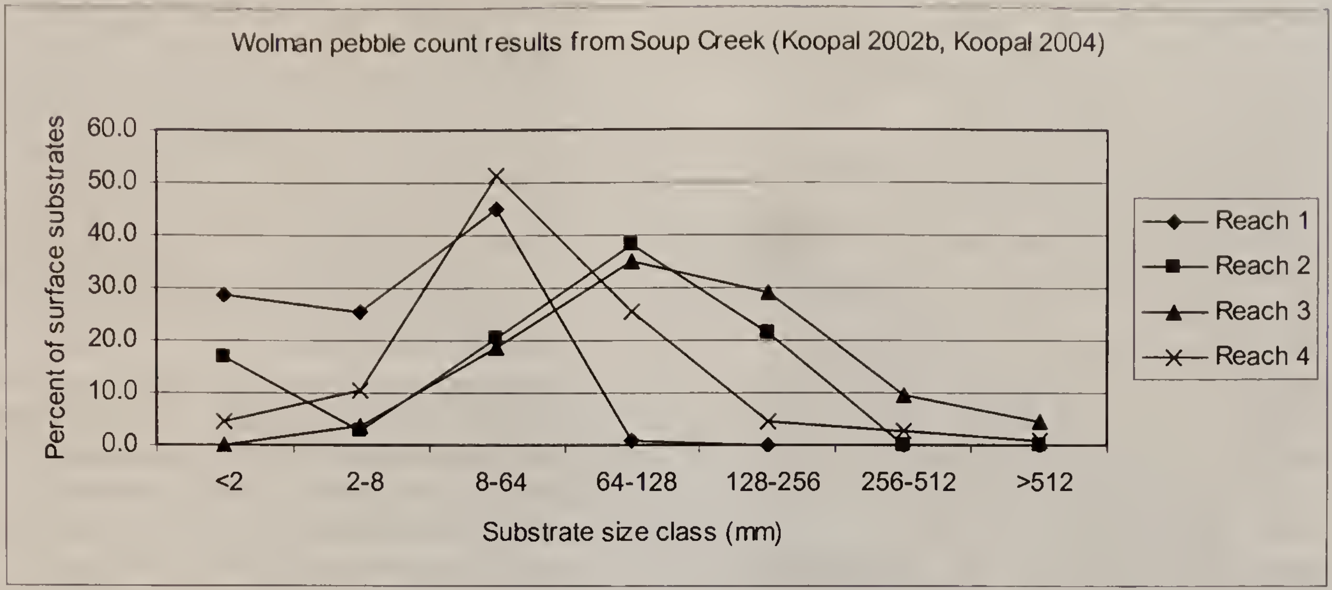


*TABLE E-21 - WOLMAN PEBBLE COUNT RESULTS FROM SOUP CREEK, 2002 (REACHES 1 AND 2) AND 2004 (REACHES 3 AND 4)*




in Reach 1. The *Wolman* pebble count results from Reaches 2 through 4 are within the expected ranges of conditions for the associated morphological types.

The final assessment of stream-sediment processes includes a description of streambank stability. Streambank stability is a measure of bank-erosion rates per stream length, and changes in the rates can be used as one indicator of potential existing impacts to fish habitats. Streambank-stability data for Soup Creek is available for the years 2002 (Reaches 1 and 2) and 2004 (Reaches 3 and 4) and includes all stream habitats from the confluence with Swan River (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 10.37) (see *TABLE E- 22 - STREAMBANK STABILITY RESULTS FROM SOUP CREEK [KOOPAL 2002B, KOOPAL 2004]*). The protocol used for collecting the streambank-stability data is that outlined in *Overton et al (1997)*. Overall, the results of this data set show very high levels (99.59 to 100 percent) of streambank stability through Reaches 1 through 4 in the project area.

(In terms of the sediment component of bull trout and westslope cutthroat trout habitat, the potential effects of past and present road construction in the Soup Creek drainage are considered unspecified, collective effects. This broad variable is consequently addressed in the *Existing Collective Past and Present Impacts* section of

*TABLE E-22 - STREAMBANK STABILITY RESULTS FROM SOUP CREEK (KOOPAL 2002B,*

| REACH | BANK LENGTH (FEET) | | PERCENT STABLE BANK | PERCENT UNSTABLE BANK | PERCENT UNDERCUT BANK |
|---|---|---|---|---|---|
| | LEFT | RIGHT | MEAN | MEAN | MEAN |
| 1 | 36,100.0 | 36,165.0 | 99.59 | 0.41 | 3.18 |
| 2 | 3,440.0 | 3,433.0 | 99.85 | 0.15 | 2.77 |
| 3 | 10,897.0 | 10,919.0 | 100.00 | 0.00 | 2.63 |
| 4 | 4,560.0 | 4,542.0 | 100.00 | 0.00 | 1.51 |

*EXISTING CONDITIONS* of this analysis.)

The most recent *McNeil* core data (*1998 through 2005*) indicates that the substrates of known spawning reaches are "threatened", and the substrate scores from 2004 and 2005 describing streambed substrate embeddedness also indicates that known bull trout rearing habitat is "threatened". The *Wolman* pebble counts also suggest that high levels of fine (less than 8 millimeters) streambed surface substrates are in Reach 1. On the contrary, a recent streambank-stability assessment in Reach 1 shows very low levels of potential streambank erosion, a natural source of sedimentation. Reasons for the measured levels of fine substrates in Reach 1 may include land-management-related activities, natural cycles in sediment-transport processes, drought-related low seasonal flows, or a combination of two or more of these and other factors. As 3 historic, native-material bridges are in the process of failing within Reaches 3 and 4, land-management-related activities cannot be conclusively ruled out as a potential source of a portion of fine substrates found in Reach 1. In general, however, measurements of substrate within Reaches 2 through 4 are within the expected ranges of conditions for the respective morphological stream type. Based on these observations, low to moderate direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat are likely in Soup Creek.

- **Soup Creek Habitat - Channel Forms**

Two descriptions of channel formation will also be used to describe existing bull trout and westslope cutthroat trout habitat in South Fork Lost Creek: *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream gradient of Reach 1 (see *FIGURE E-2 - THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) primarily ranges from 1 to 2 percent, from 3 to 5 percent in Reaches 2 and 4, and from 7 to 8 percent in Reach 3. The stream formations of Reaches 1, 2 and 4 are broadly described as exhibiting 'forced pool-riffle', 'step-pool', 'forced step-pool', and 'plane bed' *Montgomery/Buffington* classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). 'Forced step-pool' channel forms are also generally a function of large-woody-debris recruitment to the bankfull area of the stream, and the channel form typically has pool frequencies of 1:1 to 1:4 and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'step-pool' is similar to the 'forced step-pool' classification, but the formations are primarily sediment dependent as opposed to large-woody-debris dependent. The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*). The stream formations of

Reach 3 are broadly described as exhibiting 'step-pool' and 'cascade' *Montgomery/Buffington* classifications. The 'cascade' channel form generally occurs in steeper channels where longitudinal and lateral disorganization of cobbles and boulders typically prevent the development of large pools (*Montgomery and Buffington 1997*).

The *R1/R4 Fish Habitat Standard Inventory* is a useful protocol for describing detailed existing conditions and tracking temporal changes in the relative proportions of different stream microhabitats used by bull trout, westslope cutthroat trout, and other native fisheries. Inventory data for Soup Creek is available for the years 2002 and 2004 (see *TABLE E-23 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUP CREEK [KOOPAL 2002B, KOOPAL 2004])* and includes all stream habitats from the confluence with the Swan River (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 10.37) (see *FIGURE E-2 - THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*). In order to simplify the description of existing conditions, detailed habitat data from Reaches 1 through 4 has been consolidated into fast and slow habitat types. Fast habitats include stream features such as cascades, high and low gradient riffles, runs, and glides. Slow habitats include dammed pools, lateral scour pools, midchannel scour pools, plunge pools, and step pools. Bull trout and westslope cutthroat trout utilize all of the habitat types with varying frequency throughout the different life stages, although long-term persistence within a stream by all life stages of each species is generally limited by the amount and frequency of different slow habitat types. Increasing amounts of different pool habitats are typically proportional to increasing levels of bull trout and westslope cutthroat trout stream-habitat quality .

The following existing conditions can be deduced from the 2002 and 2004 habitat inventories:

- The habitat data for Reach 1 indicates that 62 percent of all channel forms are fast-type habitat features, and the remaining 38 percent of all channel forms are slow-type habitat features; approximately 19 percent of the total reach area includes

***TABLE E-23 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM SOUP CREEK (KOOPAL 2002B, KOOPAL 2004)***

| REACH | HABITAT TYPE | TOTAL NUMBER OF UNITS | MEAN HABITAT LENGTH (FEET) | MEAN WIDTH (FEET) | MEAN HABITAT DEPTH (FEET) | MEAN WIDTH/ DEPTH RATIO | MEAN HABITAT AREA (SQUARE FEET) | MEAN HABITAT VOLUME (CUBIC FEET) |
|---|---|---|---|---|---|---|---|---|
| 1 | Fast | 318 | 96.4 | 11.2 | 0.36 | 34.92 | 1,082.8 | 389.1 |
| 1 | Slow | 193 | 27.2 | 15.7 | 1.04 | 16.59 | 426.9 | 444.9 |
| 2 | Fast | 35 | 84.0 | 12.3 | 0.33 | 37.52 | 1,034.9 | 346.1 |
| 2 | Slow | 17 | 18.4 | 15.4 | 1.03 | 15.44 | 283.6 | 289.5 |
| 3 | Fast | 90 | 96.9 | 15.0 | 0.47 | 33.41 | 1,452.8 | 679.2 |
| 3 | Slow | 78 | 27.4 | 14.4 | 0.94 | 16.34 | 395.2 | 370.7 |
| 4 | Fast | 42 | 87.9 | 11.7 | 0.29 | 41.99 | 1,025.1 | 299.3 |
| 4 | Slow | 42 | 19.8 | 13.6 | 0.79 | 18.17 | 270.2 | 212.3 |

slow-type habitat features, and approximately 41 percent of the total reach volume is in slow-type habitat features.

- The habitat data for Reach 2 indicates that 67 percent of all channel forms are fast-type habitat features, and the remaining 33 percent of all channel forms are slow-type habitat features; approximately 12 percent of the total reach area includes slow-type habitat features, and approximately 29 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 3 indicates that 54 percent of all channel forms are fast-type habitat features, and the remaining 46 percent of all channel forms are slow-type habitat features; approximately 19 percent of the total reach area includes slow-type habitat features, and approximately 32 percent of the total reach volume is in slow-type habitat features.
- The habitat data for Reach 4 indicates that 50 percent of all channel forms are fast-type habitat features, and the remaining 50 percent of all channel forms are slow-type habitat features; approximately 21 percent of the total reach area includes slow-type habitat features, and approximately 42 percent of the total reach volume is in slow-type habitat features.

This information portrays Reaches 1 and 4 as having relatively high proportions of slow, or pool, habitat features and Reaches 2 and 3 as having relatively lower proportions of pool habitat features. It can also be inferred that Reaches 1 and 4 have relatively higher levels of channel complexity, in-stream cover, and potential wintering habitat. Considering reach gradients, valley location, and geomorphological processes, the observed proportions of habitat types for each reach are within the broad ranges of expected conditions.

No specific conclusions regarding trends in channel form can be drawn from these current observations, but this data will be indispensable in future-habitat assessment and monitoring efforts. Although insufficient data is available for describing specific trends in channel forms, no direct and indirect impacts to the channel-form component of bull trout and westslope cutthroat trout habitat are apparent in Soup Creek.

- **Soup Creek Habitat – Riparian Function**

The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, the interception of solar radiation, stream-nutrient inputs, and other variables (*Hansen et al 1995*). This section will consider the following important existing conditions of the riparian area: stand type, site potential tree height, and stream shading.

The predominant riparian stand types along Soup Creek within the project area include various grand fir and Engelmann spruce series. Although grand fir and Engelmann spruce are typically the dominant species during late seral and climax stages, other species such as subalpine fir, Douglas-fir, western larch, and Sitka alder are also components of the overstory (*Hansen et al 1995*). Furthermore, the riparian stand type as it relates to the associated

geology and soils can be classified as exhibiting NL2A (Reach 1 only), SL2B, and SL3B characteristics, which primarily occur adjacent to B and C channel types with stream gradients ranging from 1 to 12 percent (*Sirucek and Bachurski 1995*). The NL2A riparian landtype generally occurs at sites with deep, weakly developed, very gravelly sandy loams or very gravelly loams (*Sirucek and Bachurski 1995*). Where the SL2B and SL3B riparian landtypes occur with the stand types described above, expected conditions are somewhat poorly drained sites with deep, weakly developed, gravely or bouldery, sandy loams or loams (*Sirucek and Bachurski 1995*).

Specific riparian stand conditions adjacent to Soup Creek were assessed in 2004 through 6 riparian forest surveys in Sections 26 and 27, T24N, R17W ("Lower Soup Riparian Cruise") and 6 riparian forest surveys in Section 25, T24N, R17W ("Upper Soup Riparian Cruise"). During the surveys, all trees (live and dead) with a dbh were recorded. Results of the "Lower Soup Riparian Cruise" surveys indicate that the quadratic mean diameter of riparian trees is 5.9 inches, the average number of trees per acre is 1,032, and the average basal area per acre is 195.9 square inches. Results of the "Upper Soup Riparian Cruise" surveys indicate that the quadratic mean diameter of riparian trees is 8.5 inches, the average number of trees per acre is 262, and the average basal area per acre is 104.2 square inches. Based on data reflecting relatively low quadratic mean diameters and basal areas from the two separate surveys, a relatively low frequency of large trees in the riparian areas of Soup Creek is likely within the project area.

Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site potential tree height of dominant and co-dominant trees at 100 years (*ARM 36.11.425[5]*) is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest units in Sections 25, 26, and 27, T24N, R17W. The site potential tree height calculated during the "Lower Soup Riparian Cruise" surveys is approximately 83 feet, and the site potential tree height calculated during the "Upper Soup Riparian Cruise" surveys is approximately 74 feet. The calculations of each measure are displayed in *TABLE E-24 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("LOWER SOUP RIPARIAN CRUISE")* and *TABLE E-25 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("UPPER SOUP RIPARIAN CRUISE")*.

Riparian areas also provide stream shading, which contributes to the regulation of stream-temperature regimes by intercepting direct solar radiation to the stream channel. During winter seasons, riparian areas may also function to regulate stream temperatures by inhibiting temperature loss through evaporation, convection, or long-wave radiation from the stream (*Beschta et al 1987*). The degree to which a riparian area blocks direct solar radiation to the stream can be determined by measuring the angular canopy density, which is a function of riparian tree

*TABLE E-24 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("LOWER SOUP RIPARIAN CRUISE")**

| SAMPLE | SPECIES | HEIGHT (FEET) | AGE (YEARS) | SITE INDEX (BEST FIT) | SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET) | MEAN SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET) | REFERENCE |
|---|---|---|---|---|---|---|---|
| Lower, 1 | Grand fir | 42 | 105 | 30 | 91 | | USFS RN-71 |
| Lower, 2 | Engelmann spruce | 30 | 61 | 25 | 43 | | USFS RN-42 |
| Lower, 3 | Grand fir | 52 | 101 | 30 | 91 | | USFS RN-71 |
| Lower, 4 | Grand fir | 23 | 54 | 30 | 91 | | USFS RN-71 |
| Lower, 5 | Grand fir | 35 | 88 | 30 | 91 | | USFS RN-71 |
| Lower, 6 | Grand fir | 32 | 57 | 30 | 91 | | USFS RN-71 |
| Average value for "Lower Soup Riparian Cruise" | | | | | | 83 | |

**During July 2004, DNRC personnel took samples from random dominant and co-dominant trees with average growth at a distance of 50 feet from the bankfull slope break.*

*TABLE E-25 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT ALONG SOUP CREEK ("UPPER SOUP RIPARIAN CRUISE")**

| SAMPLE | SPECIES | HEIGHT (FEET) | AGE (YEARS) | SITE INDEX (BEST FIT) | SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET) | MEAN SITE POTENTIAL TREE HEIGHT AT 100 YEARS (FEET) | REFERENCE |
|---|---|---|---|---|---|---|---|
| Upper, 1 | Douglas-fir | 45 | 42 | 50 | 69 | | USFS RN-47 |
| Upper, 2 | Engelmann spruce | 64 | 96 | 45 | 69 | | USFS RN-42 |
| Upper, 3 | Engelmann spruce | 66 | 66 | 55 | 82 | | USFS RN-42 |
| Upper, 4 | Engelmann spruce | 71 | 79 | 55 | 82 | | USFS RN-42 |
| Upper, 5 | Douglas-fir | 72 | 109 | 50 | 69 | | USFS RN-47 |
| Average value for "Upper Soup Riparian Cruise" | | | | | | 74 | |

**During July 2004, DNRC personnel took samples from random dominant and co-dominant trees with average growth at a distance of 50 feet from the bankfull slope break.*

species composition, stand age, and tree density (*Beschta et al 1987*). Samples of angular canopy density were taken at 4 locations from the center of Soup Creek during 2004, and measurements were taken for the months of July and August (the months during which direct solar radiation has the greatest potential effect on stream-temperature regimes). Results of these measurements indicate that the existing riparian tree vegetation blocks an average of 63 percent of direct solar radiation during July and an average of 75 percent of direct solar radiation during August.

Past disturbance in the riparian areas of Soup Creek include the random, selective harvesting of large trees up to approximately 30 years ago. Based on the relatively low frequency of large trees in the "Lower Soup Riparian Cruise" and "Upper Soup Riparian Cruise" data sets, this level of past random, selective riparian harvesting likely represents a potential low existing impact. The potential existing impacts are low since the result of the past associated action poses an existing low risk of reduced recruitable large woody debris over the foreseeable near future.

Potential low direct and indirect impacts to the riparian-function component of bull trout and westslope cutthroat trout habitat exist in Soup Creek.

- **Soup Creek Habitat - Large Woody Debris**

Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is a critical component in the formation of complex habitat for bull trout and westslope cutthroat trout. All life stages of bull trout and westslope cutthroat trout have been observed closely associating with large woody debris in the Flathead River basin (*Pratt 1984, Shepard et al 1984*). Large-woody-debris recruitment rates to Soup Creek throughout the project area can be described using large-woody-debris counts per stream length, and this data was collected during 2002 and 2004 as part a *R1/R4 Fish Habitat Standard Inventory (Overton et al 1997*) (see *TABLE E-26 - LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUP CREEK (KOOPAL 2002B, KOOPAL 2004)*. Large-woody-debris counts for Soup Creek include all stream habitats from the beginning of Reach 1 (river mile 0.00) upstream through the project area and to the end of Reach 4 (river mile 10.37).

Data from reference reaches (*Harrelson et al 1994*) throughout the Flathead River basin region indicates that the expected frequency of large woody debris in undisturbed A channels ranges from 62 to 332 pieces per 1,000 feet, from 74 to 172 pieces per 1,000 feet in undisturbed B channels, and from 1 to 121 pieces per 1,000 feet in undisturbed C channels (*Bower 2004*). This data suggests that the existing frequency of large woody debris in Reaches 1 through 4 of Soup Creek are within the expected range of frequencies when compared to reference reaches in the region with similar morphological characteristics.

No apparent direct and indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat exist in Soup Creek.

- **Soup Creek Habitat - Stream Temperature**

Stream-temperature data for Soup Creek is available for 2001, 2003, 2004, and 2005 and is displayed in *TABLE E-27 - STREAM-TEMPERATURE DATA FOR SOUP CREEK*. *FIGURE E-3 - THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK, CILLY CREEK, AND SOUP CREEK STREAM-TEMPERATURE LOGGERS* displays the locations of stream-temperature data recorders on Soup Creek.

***TABLE 26 - LARGE-WOODY-DEBRIS COUNT RESULTS FROM SOUP CREEK (KOOPAL 2002B, KOOPAL 2004)***

| REACH | CHANNEL TYPE | TOTAL REACH LENGTH (FEET) | TOTAL NUMBER OF SINGLE PIECES | TOTAL NUMBER OF PIECES IN AGGREGATES | TOTAL NUMBER OF ROOT WADS | TOTAL PIECES OF LARGE WOODY DEBRIS IN REACH | NUMBER OF PIECES PER 1,000 FEET |
|---|---|---|---|---|---|---|---|
| 1 | C | 35,926 | 551 | 3,118 | 42 | 4,246 | 118 |
| 2 | B | 3,427 | 59 | 213 | 7 | 279 | 81 |
| 3 | A | 10,859 | 201 | 910 | 3 | 1,114 | 103 |
| 4 | B | 4,525 | 72 | 371 | 3 | 446 | 99 |

*TABLE E-27 - STREAM-TEMPERATURE DATA FOR SOUP CREEK**

| SITE NAME | MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS) | WARMEST DAY OF MAXIMUM WEEKLY MAXIMUM TEMPERATURE (CELSIUS) | | DAYS GREATER THAN | | |
|---|---|---|---|---|---|---|
| | | DATE | MAXIMUM | 10.0 | 15.0 | 21.1 |
| | | | | CELSIUS | | |
| Soup_NWLO_WQsite_2001 | 15.6 | 07/11/01 | 16.3 | 101 | 23 | 0 |
| Soup_NWLO_WQsite_2003 | 19.0 | 07/23/03 | 19.4 | 98 | 60 | 0 |
| Soup_NWLO_WQsite_2004 | 18.2 | 07/16/04 | 19.1 | 92 | 48 | 0 |
| Soup#1_Lower_2004 | 10.5 | 07/15/04 | 11.0 | 26 | 0 | 0 |
| Soup#2_Middle_2004 | 9.6 | 07/16/04 | 10.1 | 3 | 0 | 0 |
| Soup#3_Upper_2004 | 10.2 | 08/17/04 | 10.7 | 7 | 0 | 0 |
| Soup_NWLO_WQsite_2005 | 17.9 | 08/06/05 | 18.1 | 109 | 40 | 0 |
| Soup#1_Lower_2005 | 10.0 | 08/06/05 | 10.1 | 10 | 0 | 0 |
| Soup#2_Middle_2005 | 9.2 | 08/06/05 | 9.3 | 0 | 0 | 0 |
| Soup#3_Upper_2005 | 8.8 | 08/06/05 | 8.9 | 0 | 0 | 0 |

**Samples obtained by DNRC resource specialists using Water Temp Pro (Onset Corporation) data loggers.*

The stream-temperature data indicates that the annual maximum weekly maximum temperature at the water-quality sample site has ranged from 15.6 to 19.0 degrees Celsius for the years 2001, 2003, 2004, and 2005. During these years the maximum seasonal temperature recorded at the water-quality sample site was 16.3 degrees Celsius during 2001, 19.4 degrees Celsius during 2003, 19.1 degrees Celsius during 2004, and 18.1 degrees Celsius during 2005. For comparison, a maximum seasonal temperature of 16.1 degrees Celsius was recorded during 1983 approximately 1,500 feet upstream of the water-quality sample site (*Leathe et al 1985*). A comparison to the 1983 temperature data may suggest that the maximum seasonal temperatures within Reach 1 of Soup Creek during 2003 and 2004 are potentially slightly above average.

Rates of change in stream temperature are typically variable between different stream segments, as rates of change in stream temperature are generally a function of variations in stream shading, aspect, stream volume, net radiation, evaporation, convection, conduction, groundwater interactions, and inputs from tributaries (*Beschta et al 1987*). During 2004, the rate of change in maximum weekly maximum stream temperature between Soup#3 and Soup#2 is approximately -0.3 degrees Celsius per half mile, +0.5 degrees Celsius per half mile between Soup#2 and Soup#1, and +0.7 degrees Celsius per half mile between Soup#1 and Soup_NWLO_WQsite. During 2005, the rate of change in maximum weekly maximum stream temperature between Soup#3 and Soup#2 is approximately +0.2 degrees Celsius per half mile, +0.4 degrees Celsius per half mile between Soup#2 and Soup#1, and +0.7 degrees Celsius per half mile between Soup#1 and Soup_NWLO_WQsite. Inputs from cooler groundwater likely influenced the stream-temperature regime between Soup#3 and Soup#2 during 2004, where the maximum weekly maximum stream temperature dropped appreciably at the rate of approximately 0.3 degrees Celsius per half mile. The reason for the approximate increase of 0.2 degrees Celsius

per half mile between Soup#3 and Soup#2 during 2005 is unclear, except that there may be fluctuations in groundwater interception between Soup#3 and Soup#2 from year to year. Groundwater interactions are known to affect many of the streams in the Swan River valley (*Baxter 1997, Stanford and Ward 1993*), and the stream-temperature effects of groundwater interactions likely occur periodically in other reaches of Soup Creek. However, the extent to which different groundwater interactions affect stream temperatures is generally a function of a multitude of site-specific variables and not consistent across drainages.

In respect to bull trout, some of the temperature ranges described in *TABLE E-27 - STREAM-TEMPERATURE DATA FOR SOUP CREEK* are not within the species' tolerances, as observed in various studies. *Fraley and Shepard (1989)* rarely observed juvenile bull trout in streams exceeding 15 degrees Celsius. *Gamett (2002)* did not find bull trout where maximum stream temperatures exceeded 20 degrees Celsius. *Reiman and Chandler (1999)* found that bull trout are most frequently observed in streams having summer maximum temperatures of approximately 13 to 14 degrees Celsius. Reaches 1 and 2 within Soup Creek (see *FIGURE E-2 - THREE CREEKS TIMBER SALE PROJECT SOUTH FORK LOST CREEK AND SOUP CREEK REACH BREAKS*) are known to provide habitat to bull trout; however, the relatively high seasonal temperatures associated with Reach 1 likely limit potential bull trout use only to fall, winter, and spring. Reach 2 likely provides the only year-round cold-water refugia for bull trout.

Maximum seasonal stream temperatures in Reach 1 of Soup Creek are historically high, and these seasonal maximums are likely a limiting variable to bull trout populations in Soup Creek. The apparent swift increase in seasonal maximum stream temperature in Reach 1 during 2003 and 2004 may or may not be a result of regular fluctuations in stream-temperature regimes. As a result of this uncertainty, the increase in seasonal maximum stream temperature in Reach 1 during 2003 and 2004 represents a potential low existing direct and indirect impact to the stream-temperature component of bull trout and westslope cutthroat trout habitat in Reach 1 of Soup Creek. No apparent direct and indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat exist in Reaches 2, 3, and 4 of Soup Creek.

- **Soup Creek Habitat - Connectivity**

Currently 5 bridges cross Soup Creek within and immediately adjacent to the project area in the NE1/4NW1/4 of Section 29, NW1/4SW1/4 of Section 27, NE1/4NE1/4 of Section 26, NW1/4NW1/4 of Section 25, and SE1/4NE1/4 of Section 25, all in T24N, R17W. The bridge crossings in Sections 27 and 29 are the only road stream-crossing structures that exist within bull trout habitat, and these 2 crossings provide full passage of all life stages of bull trout. All 5 bridge crossings provide full passage of all life stages of westslope cutthroat trout.

Several sets of naturally occurring cascades and small waterfalls on Soup Creek in the E1/2 of Section 27 and W1/2 of Section 26 in T24N, R17W pose

complete migration barriers to bull trout. The cascades and small waterfalls also very likely pose complete migration barriers to westslope cutthroat trout, eastern brook trout, and, if present, rainbow trout. Both bull trout and westslope cutthroat trout exist below the barriers, and only westslope cutthroat trout are known to exist upstream of the barriers.

Although the waterfall migration barriers limit bull trout and westslope cutthroat trout migration in Soup Creek, the stream features are naturally occurring and not considered an existing impact. No direct and indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat exist in Soup Creek.

- **Soup Creek – Existing Collective Past and Present Impacts**

Existing collective past and present impacts to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective existing direct and indirect impacts and other related existing actions affecting the fish-bearing streams in the project area. In order to help convey a summary of collective existing impacts within the Soup Creek portion of the project area, a matrix of existing effects to fisheries in the project area is displayed in *TABLE 28 - MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUP CREEK.*

One related action includes past and present construction of the existing road system in the project area. This variable is considered here since the related potential impacts to native fisheries are nonspecific and may include the collective inconsistent effect of sedimentation, localized suspended solids, channel constriction, channel widening, and modifications to temperature regimes. The existing road system has been assessed for specific sources of sedimentation to streams in the Soup Creek watershed. Estimates indicate that approximately 35.6 tons per year of road material are contributed to streams in the Soup Creek watershed by the existing road system (see *APPRENDIX D - WATERSHED AND HYDROLOGY ANAYLSIS*). The collective effect from the existing road system, as represented by the estimated amount of material contributed to streams, likely represents an existing moderate impact to bull trout and westslope cutthroat trout in Soup Creek.

Other related actions that are considered in the existing

***TABLE E-28 - MATRIX OF COLLECTIVE EXISTING IMPACTS TO FISHERIES IN SOUP CREEK***

| | **EXISTING IMPACTS TO BULL TROUT AND WESTSLOPE CUTTHROAT TROUT IN SOUP CREEK** |
|---|---|
| Populations - presence and genetics | Low to high |
| Habitat - flow regimes | Very low |
| Habitat - sediment | Low to moderate |
| Habitat - channel forms | None |
| Habitat - riparian function | Low |
| Habitat - large woody debris | None |
| Habitat - stream temperature | Low |
| Habitat - connectivity | None |
| Other related actions | Very low to moderate |
| *Existing collective impacts* | *Moderate* |

collective impacts are very low impacts due to fishing and other related recreational uses, and low impacts from past forest-management activities on upstream land ownerships and road and road stream-crossing construction and maintenance activities on upstream land ownerships.

The determination of existing collective effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. For example, impacts from nonnative fish species, connectivity, and sedimentation tend to have a greater level of existing risk to native fisheries than the existing impacts from flow regimes and riparian function. Determinations of existing collective impacts are, therefore, primarily a consequence of the overwhelming impact to native fish species from nonnative fish species in conjunction with existing impacts to other habitat variables. As a result of these considerations, a moderate collective impact to bull trout and westslope cutthroat trout likely exist in Soup Creek.

## ENVIRONMENTAL (ALTERNATIVE) EFFECTS TO FISHERIES

### *DIRECT AND INDIRECT EFFECTS*

The purpose of this analysis is the assessment of potential impacts to cold-water fisheries and fisheries habitat variables within the Three Creeks Timber Sale Project area as a result of implementing any one of the project alternatives. The assessment of environmental effects in this analysis is based, in part, on the assumption that recommendations (see *FISHERIES ANALYSIS SPECIALIST RECOMMENDATIONS at the end of this document*) will be implemented through the *TIMBER SALE CONTRACT* specifications and monitoring.

In each of the following subsections this assessment will describe the risk of an impact occurring. A low risk means that the impact is unlikely to occur; a moderate risk indicates that the impact may or may not (50/50) occur; and a high risk means that impact is likely to occur. A very low impact means that the impact is unlikely to be detectable or measurable, and the impact is not likely to be detrimental to the resource. A low impact means that the impact is likely to b e detectable or measurable, but the impact is not likely to be detrimental to the resource. A moderate impact means that the impact is likely to be detectable or measurable, but the impact may or may not (50/50) be detrimental to the resource. A high impact means that the impact is likely to be detectable or measurable, and the impact is likely to be detrimental to the resource.

- **Populations - Presence and Genetics**
  - ***Direct and Indirect Effects of No-Action Alternative A on Populations – Presence and Genetics***

    No direct or indirect impacts would occur to bull trout, westslope cutthroat trout, or

other fisheries population presence or genetics in South Fork Lost, Cilly, Unnamed, or Soup creeks would occur beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E on Populations – Presence and Genetics***

  *EXISTING CONDITIONS* describes the current levels of direct and indirect adverse impacts to bull trout, westslope cutthroat trout, or other fisheries population presence or genetics in South Fork Lost, Cilly, Unnamed, or Soup creeks. These existing levels of impacts are low to high in South Fork Lost Creek; high in Cilly Creek; none in Unnamed Creek; and low to high in Soup Creek. The existing impacts to native and other fisheries presence and genetics in the project area are primarily the result of displacement, predation, and genetic introgression.

  Examples of actions that may negatively affect bull trout, westslope cutthroat trout, or other fisheries population presence or genetics in the project area include the introduction of nonnative fish species, targeted fish suppression or other removal, stocking, and species introduction to previously uninhabited stream reaches. No actions associated with this alternative involve the direct or indirect manipulation of species population presence or genetics in the project area. Therefore, as a result of the selection of action alternatives, no direct and indirect impacts to bull trout, westslope cutthroat trout, or other fisheries population presence or genetics would be expected in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described in *EXISTING CONDITIONS*. Analysis of bull trout and, in some cases, westslope cutthroat trout populations through redd counts are expected to continue as part of fisheries monitoring in the project area.

- **Habitat – Flow Regimes**

  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Flow Regimes***

    No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of flow regime in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternative B on Habitat – Flow Regimes***

    Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow-regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

    An analysis of the proposed actions related to Action Alternative B indicates that the resulting cumulative increase in water yields would be 1.8 percent in South Fork Lost Creek, 9.1 percent in Cilly Creek, 5.3 percent in Unnamed Creek, and 3.1 percent in Soup Creek (see *APPENDIX D – WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-29 – EXPECTED INCREASES IN FLOW*

*TABLE E-29 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B*

| STREAM BASIN | EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE B |
|---|---|
| South Fork Lost Creek | 0.6 |
| Cilly Creek | 6.8 |
| Unnamed Creek | 4.8 |
| Soup Creek | 2.1 |

*REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 0.6- to 6.8-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 4.8 to 6.8 percent increases and consequent potential adverse effects in Unnamed and Cilly creeks, respectively, may have a minor detectable and measurable effect to native and nonnative fisheries in that stream. The potential adverse effects in the Cilly and Unnamed creeks may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative B are expected to have a very low risk of very low direct and indirect impacts to the fisheries-habitat variable of flow regime in the South Fork Lost and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly and Unnamed creeks. These potential impacts to the fisheries habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Flow Regimes***

Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow-regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

An analysis of the proposed actions related to Action Alternative C indicates that the resulting cumulative increase in water yields would be 1.7 percent in South Fork Lost

Creek, 8.6 percent in Cilly Creek, 5.0 percent in Unnamed Creek, and 2.5 percent in Soup Creek (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-30 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 0.5- to 6.3-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 4.5- to 6.3-percent increases and consequent potential adverse effects in Unnamed and Cilly creeks, respectively, may have a minor detectable and measurable effect to native and nonnative fisheries in that stream. The potential adverse effects in Cilly and Unnamed creeks may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative C are expected to have a very low risk of very low direct and indirect impacts to the fisheries habitat variable of flow regime in South Fork Lost and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly and Unnamed creeks. These potential impacts to the fisheries habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Flow Regimes***

Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of direct and indirect adverse impacts to the flow-regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

*TABLE E-30 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C*

| STREAM BASIN | EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE C |
|---|---|
| South Fork Lost Creek | 0.5 |
| Cilly Creek | 6.3 |
| Unnamed Creek | 4.5 |
| Soup Creek | 1.5 |

An analysis of the proposed actions related to Action Alternative D indicates that the resulting cumulative increase in water yields would be 2.5 percent in South Fork Lost Creek, 11.5 percent in Cilly Creek, 5.7 percent in Unnamed Creek, and 2.1 percent in Soup Creek (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-31 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 1.1- to 9.2-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 5.2- to 9.2-percent increases and consequent potential adverse effects in Unnamed and Cilly creeks, respectively, may have a minor detectable and measurable effect to native and nonnative fisheries in that stream. The potential adverse effects in Cilly and Unnamed creeks may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative D are expected to have a very low risk of very low direct and indirect impacts to the fisheries-habitat variable of flow regime in South Fork Lost and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly and Unnamed creeks. These potential impacts to the fisheries habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Flow Regimes***

Changes in flow regime can affect native and nonnative fish-spawning migration, spawning behavior, potential spawning habitat, and embryo survival. These effects typically occur through modifications of stream morphology, sediment budget, streambank stability, stream-temperature ranges, and channel formations. *EXISTING CONDITIONS* describes the very low likelihood of very low levels of

***TABLE E-31 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D***

| STREAM BASIN | EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE D |
|---|---|
| South Fork Lost Creek | 1.3 |
| Cilly Creek | 9.2 |
| Unnamed Creek | 5.2 |
| Soup Creek | 1.1 |

direct and indirect adverse impacts to the flow-regime component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

An analysis of the proposed actions related to Action Alternative E indicates that the resulting cumulative increase in water yields would be 2.4 percent in South Fork Lost Creek, 12.1 percent in Cilly Creek, 3.8 percent in Unnamed Creek, and 1.9 percent in Soup Creek (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*). *TABLE E-32 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E* describes the expected increases for each basin as a result of the proposed actions. The expected changes to flow regimes in this table are increases above those values described in *EXISTING CONDITIONS*.

The expected 0.9- to 9.8-percent increase in flow regime to basins in the project area could affect native and nonnative fisheries. However, the expected slight increases and consequent potential adverse effects in South Fork Lost, Unnamed, and Soup creeks are not likely to have detectable or otherwise measurable effects to native and nonnative fisheries in those streams. The expected 9.8-percent increase and consequent potential adverse effects in Cilly Creek may have a minor detectable and measurable impact to native and nonnative fisheries in that stream. The potential adverse effects in Cilly Creek may include impacts to spawning habitat and embryo survival through modifications of stream morphology, sediment budget, streambank stability, and channel formations.

With respect to the existing conditions described at the beginning of this analysis, these potential modifications of flow regimes as a result of the selection of Action Alternative E are expected to have a very low risk of very low direct and indirect impact to the fisheries-habitat variable of flow regime in South Fork Lost, Unnamed, and Soup creeks. The risk is low for low direct and indirect impacts to the fisheries-habitat variable of flow regime in Cilly Creek. These potential impacts to the fisheries habitat variable of flow regime would be in addition to those described in *EXISTING CONDITIONS*.

- **Habitat - Sediment**

  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat - Sediment***

    No direct or indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment in South Fork Lost, Cilly, Unnamed, or Soup creeks would be expected beyond those described under *EXISTING CONDITIONS*.

***TABLE E-32 - EXPECTED INCREASES IN FLOW REGIME FROM BASINS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E***

| STREAM BASIN | EXPECTED INCREASE (PERCENT) IN FLOW REGIMES AS A RESULT OF IMPLEMENTING ACTION ALTERNATIVE E |
|---|---|
| South Fork Lost Creek | 1.2 |
| Cilly Creek | 9.8 |
| Unnamed Creek | 3.3 |
| Soup Creek | 0.9 |

- ***Direct and Indirect Effects of Action Alternatives B on Habitat – Sediment***

*EXISTING CONDITIONS* considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate-score data, *Wolman* pebble-count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream-sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of wind-thrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D – WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative B has a low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes.

*APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS* also indicates that all road stream-crossing modifications associated with Action Alternative B would reduce sedimentation by up to approximately 19.3 tons per year in South Fork Lost Creek, 1.0 tons per year in Cilly Creek, and 33.7 tons per year in Soup Creek. These proposed modifications represent an approximate 98-, 35-, and 95-percent, respectively, maximum reduction in annual sediment delivery from existing roads. Road-modification activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout, westslope cutthroat trout, or other fisheries habitat. However, these road modifications would provide a long-term, greatly reduced level of impact to bull trout, westslope cutthroat trout, or other fisheries habitat in respect to sediment.

New road stream crossings installed as part of Action Alternative B may lead to a disproportionate increase in the quantities of fine-sediment size classes in fish-bearing streams and non-fish-bearing connected tributaries. Three new road stream crossings would be installed on a non-fish-bearing reach of Unnamed Creek. Two of the three new road stream crossings are expected to have a moderate risk of both short- and long-term moderate direct and indirect impacts (see *APPENDIX D*

- *WATERSHED AND HYDROLOGY ANALYSIS*) to the sediment component of fish habitat in downstream fish-bearing reaches of Unnamed Creek. Due to beaver dam complexes and intermittent flows in Unnamed Creek, downstream impacts to Soup Creek are expected to be very limited in risk and potential effect.

In-stream sediment size classes may be affected through inputs from the root wads of wind-thrown trees adjacent to the stream channel. Sediment inputs from the wind-thrown root wads of adjacent trees occur throughout unmanaged stream channels; however, in some cases, this process may be exacerbated by increased levels of wind-thrown trees as a result of riparian timber-harvesting actions. Sediment inputs through this mechanism may lead to a disproportionate increase in the quantities of fine sediment size classes in fish-bearing streams and non-fish-bearing-connected tributaries. The riparian landtypes where riparian harvesting is expected to occur along the fish-bearing reaches of South Fork Lost and Soup creeks include SL2B and SL3B (see *EXISTING CONDITIONS*). Both landtypes are susceptible to windthrow since the shallow water tables typically found in these areas restrict root penetration (*Sirucek and Bachurski 1995*). Furthermore, *Hansen et al (1995)* describes the western red cedar/oak fern (South Fork Lost Creek) and grand fir and Engelmann spruce (Soup Creek) riparian stand types as being susceptible to high levels of windthrow. Considering the expected extent of riparian harvesting, landtypes, and riparian stand types, a low risk of very low direct and indirect impacts to the sediment component of fish habitats throughout the project area are expected as a result of potential sedimentation from the root wads of wind-thrown trees.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types, and geology (landtype), and increases in adjacent hill slope. *APPENDIX G - SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily moderate to high risk of erosion. *TABLE E-33 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G - SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. In *TABLE E-33 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B*, 35 percent is

*TABLE E-33 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE B*

| | STREAM BASIN | | | |
|---|---|---|---|---|
| | SOUTH FORK LOST CREEK | CILLY CREEK | UNNAMED CREEK | SOUP CREEK |
| Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35-percent slope gradient | 10.8 | 14.8 | 10.2 | 23.9 |
| Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient | 7.9 | 7.4 | 5.2 | 14.6 |
| Range of slope gradients (percent) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 1 to 55 | 7 to 76 | 4 to 88 | 3 to 95 |
| Average slope gradient (percents) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 36 | 28 | 29 | 32 |

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

utilized as a descriptive value since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with an increased risk of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvest-related activities. Considering the erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat are expected throughout the project area as a result of potential sedimentation from riparian disturbances.

As a result of the selection of Action Alternative B, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment is expected in South Fork Lost, Cilly, and Soup creeks. An overall moderate risk of moderate direct and indirect impacts to the fisheries habitat component of sediment is expected in Unnamed Creek. This assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

- ***Direct and Indirect Effects of Action Alternatives C on Habitat – Sediment***

*EXISTING CONDITIONS* considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries

habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate-score data, *Wolman* pebble-count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of wind-thrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D - WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative B has a low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes. The impacts to the sediment component of fisheries habitat in the project area due to road stream-crossing removals, new road stream crossings, and root wads of wind-thrown trees are also expected to be the same as those described in Action Alternative B.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types and geology (landtype), and increases in adjacent hill slope. *APPENDIX G - SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily low to high risk of erosion. *TABLE E-34 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G - SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. Thirty-five percent is utilized as a descriptive value in this table since that

*TABLE E-34 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE C**

| | STREAM BASIN | | | |
|---|---|---|---|---|
| | SOUTH FORK LOST CREEK | CILLY CREEK | UNNAMED CREEK | SOUP CREEK |
| Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35- percent slope gradient | 1.6 | 22.8 | 10.2 | 2.8 |
| Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient | 3.5 | 6.7 | 5.2 | 2.9 |
| Range of slope gradients (percent) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 13 to 90 | 2 to 76 | 4 to 88 | 8 to 91 |
| Average slope gradient (percents) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 48 | 23 | 29 | 39 |

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with increased risks of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvest-related activities. Considering the erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat throughout the project area is expected as a result of potential sedimentation from riparian disturbance.

As a result of the selection of Action Alternative C, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment is expected in South Fork Lost, Cilly, and Soup creeks. An overall moderate risk of moderate direct and indirect impacts to the fisheries habitat component of sediment is expected in Unnamed Creek. This assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative C is selected for implementation.

- ***Direct and Indirect Effects of Action Alternatives D on Habitat – Sediment***

*EXISTING CONDITIONS* considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate-score data, *Wolman* pebble-count data, and streambank stability in South Fork Lost and Soup

creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of wind-thrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D - WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative B has a low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in the project area range from very low to low as a result of modifications to flow regimes.

*APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS* also indicates that all road stream-crossing modifications associated with Action Alternative D would reduce sedimentation by up to approximately 18.7 tons per year in South Fork Lost Creek, 0.6 tons per year in Cilly Creek, and 33.6 tons per year in Soup Creek. These proposed modifications represent an approximate 94 percent, 22 percent, and 95 percent, respectively, maximum reduction in annual sediment delivery from existing roads. Road-modification activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout, westslope cutthroat trout, or other fisheries habitat. However, these road modifications would provide a long-term, greatly reduced level of impact to bull trout, westslope cutthroat trout, or other fisheries habitat in respect to sediment.

New road stream crossings installed as part of Action Alternative D may lead to a disproportionate increase in the quantities of fine sediment size classes in fish-bearing streams and non-fish-bearing connected tributaries. Two new road stream crossings would be installed on a non-fish-bearing reach of Cilly Creek, and 3 new road stream crossings would be installed on a non-fish-bearing reach of Unnamed Creek. One of the two new road stream crossings on Cilly Creek and two of the three new road stream crossings on Unnamed Creek are expected to have a moderate risk of both short- and long-term moderate direct and indirect impacts (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*) to the sediment component of fish habitat in downstream fish-bearing reaches of Cilly and Unnamed creeks. Due to beaver dam complexes and

intermittent flows in Unnamed Creek, downstream impacts to Soup Creek are expected to be very limited in risk and potential effect.

The impacts to the sediment component of fisheries habitat in the project area due to the root wads of wind-thrown trees are expected to be the same as those described in Action Alternative B.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types and geology (landtype), and increases in adjacent hill slope. The *APPENDIX G - SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily moderate to high risk of erosion. *TABLE E-35 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range from 0 to 10 percent of that total area (see *APPENDIX G - SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. Thirty-five percent is utilized as a descriptive

***TABLE E-35 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE D****

| | STREAM BASIN | | | |
|---|---|---|---|---|
| | SOUTH FORK LOST CREEK | CILLY CREEK | UNNAMED CREEK | SOUP CREEK |
| Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35- percent slope gradient | 11.5 | 16.0 | 10.2 | 1.9 |
| Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35-percent gradient | 14.1 | 12.5 | 5.2 | 4.2 |
| Range of slope gradients (percent) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 1 to 148 | 8 to 83 | 4 to 88 | 5 to 79 |
| Average slope gradient (percents) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 40 | 33 | 29 | 42 |

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

value in this table since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with increased risks of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvest-related activities. Considering erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat is expected throughout the project area as a result of potential sedimentation from riparian disturbance.

As a result of the selection of Action Alternative D, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment is expected in South Fork Lost and Soup creeks. An overall moderate risk of moderate direct and indirect impacts to the fisheries habitat component of sediment is expected in Cilly and Unnamed creeks. This assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternatives E on Habitat – Sediment***

*EXISTING CONDITIONS* considered the sediment component of bull trout, westslope cutthroat trout, and other fisheries habitat by evaluating the *Rosgen* morphological stream type, *McNeil* core data, substrate-score data, *Wolman* pebble-count data, and streambank stability in South Fork Lost and Soup creeks. The *Rosgen* morphological stream type and field assessments of streambank disturbances were evaluated in Cilly and Unnamed creeks. No apparent existing impacts to the sediment component of habitat have been observed in South Fork Lost, Cilly, and Unnamed creeks. Low to moderate existing impacts to the sediment component of habitat are likely occurring in Soup Creek.

Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout, westslope cutthroat trout, or other fisheries in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream-channel instability, road features, root wads of wind-thrown trees adjacent to the stream channel, and adjacent timber-harvesting operations.

Data from *APPENDIX D - WATERSHED AND HYDROLOGY ANAYLSIS* indicates that the range of potential water-yield increases as a result of Action Alternative B has a low risk of facilitating the development of unstable stream channels. Potential impacts to the sediment component of fish habitats in

the project area range from very low to low as a result of modifications to flow regimes.

*APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS* also indicates that all road stream-crossing modifications associated with Action Alternative E would reduce sedimentation by up to approximately 18.7 tons per year in South Fork Lost Creek, 0.6 tons per year in Cilly Creek, and 33.9 tons per year in Soup Creek. These proposed modifications represent an approximate 94-, 35-, and 95-percent, respectively, maximum reduction in annual sediment delivery from existing roads. Road-modification activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout, westslope cutthroat trout, or other fisheries habitat. However, these road modifications would provide a long-term, greatly reduced level of impact to bull trout, westslope cutthroat trout, or other fisheries habitat in respect to sediment.

New road stream crossings installed as part of Action Alternative E may lead to a disproportionate increase in the quantities of fine sediment size classes in fish-bearing streams and non-fish-bearing connected tributaries. One new road stream crossing would be installed on a non-fish-bearing reach of Unnamed Creek. The new road stream crossing is expected to have a low risk of both short- and long-term low direct and indirect impacts (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*) to the sediment component of fish habitat in downstream fish-bearing reaches of Unnamed Creek. Due to beaver dam complexes and intermittent flows in Unnamed Creek, downstream impacts to Soup Creek are expected to be very limited in risk and potential effect.

The impacts to the sediment component of fisheries habitat in the project area due to the root wads of wind-thrown trees are expected to be the same as those described in Action Alternative B.

Harvesting activities within the riparian area may disturb soils, which can lead to erosion and increased levels of sedimentation to streams. Risk of erosion and consequent sedimentation is primarily a function of the types and extent of soil disturbance, soil types and geology (landtype), and increases in adjacent hill slope. *APPENDIX G - SOILS ANALYSIS* provides information regarding the types and extent of soil disturbance and project area soil types and geology. According to that analysis, the landtype associations within the riparian areas of South Fork Lost, Cilly, Unnamed, and Soup creeks are considered to exhibit a primarily moderate to high risk of erosion. *TABLE E-36 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E* provides an estimate of the total area within 100 feet of Class 1 and 2 streams in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup Creek watersheds with slope gradients less than and greater than 35 percent. Actual soil disturbances within 100 feet of Class 1 and 2 streams are expected to range

*TABLE E-36 - CHARACTERISTICS AND ESTIMATED EXTENT OF RIPARIAN AREAS IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF ACTION ALTERNATIVE E**

| | STREAM BASIN | | | |
|---|---|---|---|---|
| | SOUTH FORK LOST CREEK | CILLY CREEK | UNNAMED CREEK | SOUP CREEK |
| Area (acres) of proposed harvest units within 100 feet of Class 1 and 2 streams with less than 35- percent slope gradient | 6.8 | 36.4 | 9.1 | 11.5 |
| Area (area) of proposed harvest units within 100 feet of Class 1 and 2 streams with greater than 35- percent gradient | 24.4 | 9.4 | 0.5 | 6.0 |
| Range of slope gradients (percent) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 9 to 122 | 1 to 92 | 4 to 69 | 5 to 79 |
| Average slope gradient (percents) Within proposed harvest units and within 100 feet of Class 1 and 2 streams | 52 | 22 | 16 | 30 |

**Data acquired by using 1:24,000 hydrography data and 10-meter digital elevation model data developed by the U.S. Geological Survey. Areas and slopes in the table are estimates, and the accuracy of the results is limited by precision of the U.S. Geological Survey data.*

from 0 to 10 percent of that total area (see *APPENDIX G - SOILS ANALYSIS*). The precise gradient threshold at which disturbed soils within the project area become increasingly more mobile is variable and also fluctuates between different locations and environmental conditions. Thirty-five percent is utilized as a descriptive value in this table since that gradient is applied in existing SMZ laws as a general guide for identifying riparian areas with increased risk of erosion.

Timber-harvesting operations adjacent to South Fork Lost, Cilly, Unnamed, and Soup creeks would comply with SMZ laws. SMZ laws are designed to provide adequate mitigations for avoiding sedimentation to streams from adjacent timber-harvesting-related activities. Considering the erosion risk of landtypes in riparian areas and the extent of potential riparian soil disturbance, a low risk of low direct and indirect impacts to the sediment component of fisheries habitat is expected throughout the project area as a result of potential sedimentation from riparian disturbance.

As a result of the selection of Action Alternative E, an overall low risk of low direct and indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of sediment is expected. The risk assessment applies to fisheries in South Fork Lost, Cilly, Unnamed, and Soup creeks, and the assessment uses data from *EXISTING CONDITIONS* as a baseline for comparison. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative E is selected for implementation.

- Habitat - Channel Forms

  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Channel Forms***

    No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of channel forms in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternatives B and C on Habitat – Channel Forms***

    As described in *EXISTING CONDITIONS*, no direct or indirect impacts to the channel-form component of bull trout, westslope cutthroat trout, and other fisheries habitat are apparent in South Fork Lost, Cilly, Unnamed, and Soup creeks. Potential changes to stream-channel forms are primarily a function of modifications to flow regimes and consequent relationships with existing sediment size classes (*Montgomery and Buffington 1997*). Adverse impacts to flow regimes and existing sediment size classes may affect channel forms by shifting the relative quantities of slow and fast habitat features. The likely manifestation of this type of adverse impact is a decrease in the total volume of slow habitat features and an increase in the total volume of fast habitat features. This shift in channel forms may lead to a reduction in the quantity of rearing and wintering habitat available to bull trout, westslope cutthroat trout, and other fisheries.

    As indicated in the risk assessment for flow regime, a very low risk of very low impacts is expected in South Fork Lost and Soup creeks and a low risk of low impacts is expected in Cilly and Unnamed creeks. As indicated in the risk assessment for sediment, a low risk of low impacts is expected in the South Fork Lost, Cilly, and Soup creeks and a moderate risk of moderate impacts is expected in Unnamed Creek. A comparable, or overall low risk of low direct and indirect impacts to channel forms is expected in South Fork Lost, Cilly, and Soup creeks as a result of implementing an action alternative. A moderate risk of low direct and indirect impacts to channel forms is expected in Unnamed Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if an action alternative is selected for implementation.

  - ***Direct and Indirect Effects of Action Alternative D on Habitat - Channel Forms***

    The results of risk assessments for flow regime and sediment are similar to those identified in Action Alternative B, except a moderate risk of moderate impacts is expected for the sediment component of fish habitat in Cilly Creek. As a result of the selection of Action Alternative D, the anticipated direct and indirect impacts to the fisheries habitat variable of channel forms in South Fork Lost and Soup creeks are expected to be the same as those described for Action Alternative B. A moderate risk of low direct and indirect impacts to channel forms is expected in both Cilly and Unnamed creeks. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if

Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E on Habitat - Channel Forms***

  As indicated in the risk assessment for flow regime, a very low risk of very low impacts is expected in South Fork Lost, Cilly, and Soup creeks and a low risk of low impacts is expected in Unnamed Creek. As indicated in the risk assessment for sediment, a low risk of low impacts is expected in South Fork Lost, Cilly, Unnamed, and Soup creeks. A comparable, or overall low risk of low direct and indirect impacts to channel forms is expected in South Fork Lost, Cilly, and Soup creeks as a result of implementing an action alternative. A moderate risk of low direct and indirect impacts to channel forms is expected in Unnamed Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if an action alternative is selected for implementation.

- **Habitat - Riparian Function**

  - ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Riparian Function***

    No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of riparian function in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternative B on Habitat – Riparian Function***

    *EXISTING CONDITIONS* describes low levels of direct and indirect impacts to the riparian-function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

    The proposed action associated with Action Alternative B that could further affect riparian function is selective riparian harvesting. Specific variables of riparian function that may be affected by the selective riparian harvesting are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

    Action Alternative B proposes a selective riparian harvest adjacent to approximately 2,950 feet of South Fork Lost Creek in in Unit 8 in Section 3, T24N, R17W; this harvest lies entirely south of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer of 25 feet from the nearest bankfull edge of South Fork Lost Creek; from 25 feet to 95 feet, a maximum of 50 percent of trees 8 inches dbh or greater would be harvested. The proposed selective riparian harvest, which would extend approximately 2,950 feet, is representative of approximately 3 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

    The riparian stand type along South Fork Lost Creek (western red cedar/oak fern) is likely to remain after implementing the

riparian harvest prescription. (The western red cedar/oak fern stand type is named after the climax vegetation community.) However, as grand fir comprises a considerable proportion of the existing low and midlevel riparian tree vegetation along South Fork Lost Creek, this species will likely become co-dominant throughout the forthcoming climax stages within the riparian area. Growth of early successional tree species of the existing stand type, such as western larch and western white pine, are expected to remain minor components of the riparian species composition. However, the postharvest site preparation for proposed Unit 8, in Section 3, T24N, R17W, may promote the growth of more western larch and western white pine and less western red cedar and grand fir.

*EXISTING CONDITIONS* describes levels of potentially recruitable large woody debris from the riparian area along South Fork Lost Creek as a quadratic mean diameter of 9.1 inches, an average of 764 trees (live and dead standing) per acre, and an average basal area per acre of 346.0 square inches. After modifying the riparian cruise data to simulate the residual stand conditions subsequent to implementing the proposed riparian harvest prescription, the expected levels of potentially recruitable large woody debris would (1) remain the same from the nearest bankfull edge of South Fork Lost Creek to 25 feet, and (2) from 25 to 95 feet would include a quadratic mean diameter of 7.7 inches, an average of 674 trees per acre, and an average basal area per acre of 217.6 square inches. The estimated trees per acre in the area between 25 and 95 feet from the bankfull edge of the stream would drop approximately 12 percent, but this fraction of trees would also represent an approximate 37 percent reduction of basal area per acre within the same area. Windthrow and windsnap within the riparian area is likely to increase above existing levels after implementing the proposed riparian harvest prescription. These events may further reduce the residual standing trees per acre and basal area within the riparian area.

The general probability of a riparian tree providing in-stream large woody debris (as part of riparian function) is a result of many variables, such as distance from the stream, height of the tree, other riparian trees that may deflect fall direction, tree bole breakage, riparian sideslope gradient, and prevailing local storm winds. Furthermore, determining the probability of a particular tree size class contributing to in-stream large woody debris is a function of additional variables such as average growth rates of different species, susceptibilities to windthrow and windsnap, species canopy density, the average heights of different species, and different species' responses to disease and shade. The analysis of these scenarios and variables is beyond the scope of this environmental assessment. However, the results of a simple quantitative analysis will follow based on the typical characteristics of 100-year-old index trees found through site review are summarized below. (The details of this simple quantitative analysis can be found in a separate document in the project file: Fisheries Analysis of Riparian Function - Simple Quantitative Analysis of 100-Year-Old Trees.) The 100-

year-old index tree is an appropriate indicator since the tree may represent an average piece of residual recruitable large woody debris throughout a foreseeable riparian-management-zone entry cycle.

The proposed riparian harvest prescription is expected to decrease the proportion of potentially recruitable 100-year-old trees to the 2,950-foot reach of South Fork Lost Creek by approximately 3 percent. Although notable, based on the riparian cruise data, the basal area equivalent of this proportion of riparian trees is comparable to 61.5 square inches per acre or approximately 18 percent of the existing basal area per acre.

The estimated 3-percent reduction in potentially recruitable 100-year-old trees carries a moderate level of error, as errors associated with the data collection, sampling error, and probability formulas were not factored. The true value is also likely higher considering an existing road prism is north of South Fork Lost Creek, which certainly eliminates a small portion of potentially recruitable 100-year-old trees. The value is also a snapshot in time, and the estimated reduction is expected to be negligible after trees of smaller diameter grow into the eligible size criteria used in this assessment. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

By establishing the outer boundary of the RMZ at 95 feet in accordance with *ARM 36.11.425 (5)* and implementing the proposed riparian harvest prescription, the majority of riparian trees that currently grow between 77 and 95 feet from the nearest bankfull edge of South Fork Lost Creek will also be retained. Seventy-seven feet is the effective height of an average 100-year-old co-dominant riparian tree bole that comprises potentially recruitable large wood debris (*Robinson and Beschta 1990*). A portion of these trees will undoubtedly be greater than 100 years old and exhibit effective heights taller than 77 feet for additional potentially recruitable large woody debris.

Reductions in recruitable large woody debris from the riparian area may affect native and nonnative fish by altering in-stream large woody debris frequency (see *Habitat - Large Woody Debris*).

*EXISTING CONDITIONS* describes levels of shading (angular canopy density) in South Fork Lost Creek during peak summer months. Existing riparian tree vegetation blocks an average of 65 percent of direct solar radiation during July and an average of 81 percent of direct solar radiation during August. Potential changes to stream shading during peak summer months after implementing the proposed riparian harvest prescription are a function of many variables, such as residual canopy density, residual crown characteristics, sideslope gradients, and residual species composition. Although a numerical prediction would, therefore, contain a high degree of uncertainty, broad generalizations can be applied to estimate potential effects. A compilation of related literature (*Castelle and Johnson 2000*) found that a 49-foot buffer provides approximately 85 percent of the maximum shade

available for small streams, a 56-foot buffer provides approximately 90 percent of the maximum available angular canopy density, and a 79-foot buffer typically provides the maximum available shading to a stream. The proposed selective riparian harvest would occur entirely to the south of South Fork Lost Creek, which includes the riparian area providing the bulk of existing stream shading. Considering this data and the proposed riparian harvest prescription, which includes a no-cut buffer from the nearest bankfull edge of South Fork Lost Creek out to 25 feet and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 95 feet, a maximum reduction in angular canopy density is expected to be 20 percent during the months of July and August. This estimated reduction in shading is also expected to become negligible as the riparian area between 25 feet and 95 feet regenerates to preharvest conditions. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

Reductions in shading by the riparian area may affect native and nonnative fish primarily by altering the stream temperature (see *Habitat - Stream Temperature*).

Other proposed harvest units that are adjacent to South Fork Lost Creek include Units 15 and 19 in Section 4, Unit 5 in Section 3, and Unit 3 in Section 1, all in T24N, R17W. These 4 proposed units are located at least 140 feet from South Fork Lost Creek and are not expected to affect riparian functions.

After an assessment of potential effects, which includes:

- an affected area equal to approximately 3 percent of the total riparian area adjacent to bull trout or westslope cutthroat trout habitat,
- no foreseeable adverse effects to stand type (such as shifts in stand type),
- a relatively minor reduction in potentially recruitable large woody debris, and
- an estimated maximum reduction in stream shading of 20 percent,

an overall moderate risk of low direct and indirect impacts to the riparian function component of fish habitat are expected in South Fork Lost Creek.

No proposed harvest units are adjacent to fish-bearing reaches of Cilly and Unnamed creeks. A selective riparian harvest in accordance with the SMZ Law and Rules for Class 1 streams would occur along approximately 59 percent (6,470 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek and along approximately 68 percent (3,830 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not expected to have adverse impacts to stand types, such as shifts in stand type, and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

Action Alternative B also proposes selective riparian harvesting adjacent to approximately 5,890 combined feet of Soup Creek in proposed Units 5 and 11 in Section 27, ('Lower' Soup area) and Units 12

and 13 in Section 25 ('Upper' Soup Area), all in T24N, R17W, which lie entirely north of the stream channel with the exception of one 140-foot reach south of the stream. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and harvesting a maximum of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. (Although the site potential tree height within the 'Lower' Soup area [83 feet] surpasses that found in the 'Upper' Soup area [74 feet]), the data from the 'Lower' Soup area will be applied to the proposed riparian harvest prescriptions throughout the main Soup Creek drainage.). The proposed selective riparian harvest, which would extend approximately 5,890 feet, is representative of approximately 6 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

The riparian stand types along Soup Creek (various grand fir and Engelmann spruce series) are likely to remain after implementing the riparian harvest prescription. Other early and late successional tree species of the existing stand type, such as Douglas-fir and subalpine fir, are expected to remain minor components of the riparian species composition.

*EXISTING CONDITIONS* describes levels of potentially recruitable large woody debris from the riparian area along 'Lower' Soup Creek as a quadratic mean diameter of 5.9 inches, an average of 1,032 trees per acre, and an average basal area per acre of 195.9 square inches. After modifying the riparian cruise data in this area to simulate the residual stand conditions subsequent to implementing the proposed riparian harvest prescription, the expected levels of potentially recruitable large woody debris would (1) remain the same from the nearest bankfull edge of Soup Creek to 25 feet, and (2)from 25 to 83 feet would include a quadratic mean diameter of 4.9 inches, an average of 962 trees per acre, and an average basal area per acre of 123.6 square inches. The estimated trees per acre in the area between 25 and 83 feet from the bankfull edge of the stream would drop approximately 7 percent, but this fraction of trees would also represent an approximate 37-percent reduction of basal area per acre within the same area. Windthrow and windsnap within the riparian area would likely increase above existing levels after implementing the proposed riparian harvest prescription. These events may further reduce the residual trees per acre and basal area within the 'Lower' Soup Creek riparian area.

*EXISTING CONDITIONS* describes levels of potentially recuitable large woody debris from the riparian area along 'Upper' Soup Creek as a quadratic mean diameter of 8.5 inches, an average of 262 trees per acre, and an average basal area per acre of 104.2 square inches. After modifying the riparian cruise data in this area to simulate the residual stand conditions subsequent to implementing the proposed riparian harvest prescription, the expected levels of potentially recruitable large woody debris would (1) remain the same from the nearest bankfull edge of Soup Creek to 25 feet, and (2) from 25 to 83 feet would include a quadratic mean diameter of 7.1 inches, an average of 212 trees per acre,

and an average basal area per acre of 58.8 square inches. The estimated trees per acre in the area between 25 and 83 feet from the bankfull edge of the stream would drop approximately 19 percent, but this fraction of trees would also represent an approximate 44-percent reduction of basal area per acre within the same area. Windthrow and windsnap within the riparian area is likely to increase above existing levels after implementing the proposed riparian harvest prescription. These events may further reduce the residual trees per acre and basal area within the 'Upper' Soup Creek riparian area.

Similar to the assessment of rates of potential large-woody-debris recruitment previously described for South Fork Lost Creek within this section, the results of a simple quantitative analysis for the 'Lower' and 'Upper' Soup Creek riparian areas will follow based on the typical characteristics of 100-year-old index trees found through site review are summarized below. (The details of this simple quantitative analysis can be found in a separate document in the project file: *Fisheries Analysis of Riparian Function - Simple Quantitative Analysis of 100-Year-Old Trees*.) The 100-year-old index tree is an appropriate indicator since the tree may represent an average piece of residual recruitable large woody debris throughout a foreseeable riparian-management-zone entry cycle.

The proposed riparian harvest prescription is expected to decrease the proportion of potentially recruitable 100-year-old trees to the 2,480-foot reach ('Lower' Soup) of Soup Creek by approximately 4 percent. Based on the riparian cruise data, the basal-area equivalent of this proportion of riparian trees is comparable to 55.3 square inches per acre, or approximately 28 percent of the existing basal area per acre.

The proposed riparian harvest prescription is expected to decrease the proportion of potentially recruitable 100-year-old trees to the 3,410-foot reach ('Upper' Soup) of Soup Creek by approximately 6 percent. Based on the riparian cruise data, the basal-area equivalent of this proportion of riparian trees is comparable to 32.8 square inches per acre or approximately 32 percent of the existing basal area per acre.

The estimated 4- and 6-percent reductions in potentially recruitable 100-year-old trees to 'Lower' and 'Upper' Soup Creek riparian areas, respectively, carries a moderate level of error, as errors associated with the data collection, sampling error, and probability formulas were not factored. The true value is also likely higher considering existing road prisms are north of Soup Creek, which certainly eliminates a small portion of potentially recruitable 100-year-old trees. The value is also a snapshot in time, and the estimated reduction is expected to be negligible after trees of smaller diameter grow into the eligible size criteria used in this assessment. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

By establishing the outer boundary of the RMZ at 83 feet, in accordance with *ARM 36.11.425 (5)* and implementing the proposed riparian harvest

prescription, the majority of riparian trees that currently grow between 51 ('Lower' Soup area) and 58 feet ('Upper' Soup area) and 83 feet from the nearest bankfull edge of Soup Creek will also be retained. Fifty-one and 58 feet are the effective heights of an average 100-year-old co-dominant riparian tree bole that comprises potentially recruitable large woody debris (*Robinson and Beschta 1990*). A portion of these trees will undoubtedly be greater than 100 years old and exhibit effective heights taller than 51 and 58 feet for additional potentially recruitable large woody debris.

*EXISTING CONDITIONS* describes levels of shading (angular canopy density) in Soup Creek during peak summer months. Existing riparian tree vegetation blocks an average of 63 percent of direct solar radiation during July and an average of 75 percent of direct solar radiation during August. Potential changes to stream shading during peak summer months after implementing the proposed riparian harvest prescription are a function of many variables, such as residual canopy density, residual crown characteristics, sideslope gradients, and residual species composition. Although a numerical prediction would, therefore, contain a high degree of uncertainty, broad generalizations can be applied to estimate potential effects. A compilation of related literature (*Castelle and Johnson 2000*) found that a 49-foot buffer provides approximately 85 percent of the maximum shade available for small streams, a 56-foot buffer provides approximately 90 percent of the maximum available angular canopy density, and a 79-foot buffer typically provides the maximum available shading to a stream. The proposed selective riparian harvest would occur almost entirely to the north of Soup Creek, which includes the riparian area providing the least amount of existing stream shading. Considering this data and the proposed riparian harvest prescription, which includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet, a maximum reduction in angular canopy density of 5 percent is expected during the months of July and August. This estimated reduction in shading is also expected to become negligible as the riparian area between 25 and 83 feet regenerates to preharvest conditions. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

Unit 19 in Section 27, T24N, R17W is also adjacent to Soup Creek, though this proposed unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

After an assessment of potential effects, which includes:

- an affected area equal to approximately 6 percent of the total riparian area adjacent to bull trout or westslope cutthroat trout habitat,
- no foreseeable adverse effects to stand type (such as shifts in stand type),
- a relatively minor reduction in potentially recruitable large woody debris, and

- an estimated maximum reduction in stream shading of 5 percent,

an overall moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat in Soup Creek.

As a result of implementing Action Alternative B, a moderate risk of low direct and indirect impacts to the riparian-function component of fisheries habitat are expected within South Fork Lost, Cilly, Unnamed, and Soup creeks. The low expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Riparian Function***

*EXISTING CONDITIONS* describes low levels of direct and indirect impacts to the riparian function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

The proposed action associated with Action Alternative C that could further affect riparian function is a selective riparian harvest. Specific variables of riparian function that may be affected by the selective riparian harvest are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

Action Alternative C does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14, 15, 19, 20, and 22 in Section 4 and Unit 5 in Section 3, all in T24N, R17W, are adjacent to South Fork Lost Creek. These 6 proposed units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian functions of standtype composition, the quantity of recruitable large woody debris within the site potential tree height, and stream shading. As a result of selecting Action Alternative C, no foreseeable, or otherwise detectable, adverse direct and indirect impacts to the riparian function component of fish habitat are expected in South Fork Lost Creek.

Action Alternative C proposes selective riparian harvesting adjacent to approximately 650 feet of Cilly Creek in proposed Unit 23 in Section 16, T24N, R17W, which spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet, in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 650 feet, is representative of approximately 3 percent of the total linear riparian area adjacent to the reaches of the stream that currently provide habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include potential moderately reduced levels of recruitable large woody debris and reduced levels of stream shading.

A selective riparian harvest, in accordance with the SMZ Law and

Rules for Class 1 streams, would occur along approximately 49 percent (5,350 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek. This upstream harvest is expected to have no adverse impacts to stand types (such as a shift in stand type) and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Cilly Creek, which includes:

- an affected area equal to approximately 3 percent of the total riparian area adjacent to eastern brook trout habitat,
- a potential moderate reduction in recruitable large woody debris to the fish-bearing reach,
- a potential moderate reduction in stream shading to the fish-bearing reach, and
- a potential moderate reduction in stream shading to the non-fish-bearing reach,

a moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat are expected in that stream.

No proposed harvest units are adjacent to the fish-bearing reaches of Unnamed Creek. A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 68 percent (3,830 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not expected to have any adverse impacts to stand types and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Unnamed Creek, which includes a potential moderate reduction in stream shading to the non-fish-bearing reach, a moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat are expected in that stream.

Action Alternative C proposes a selective riparian harvest adjacent to approximately 140 combined feet of Soup Creek in proposed Unit 11 in Section 27, T24N, R17W ('Lower' Soup area), which lies entirely south of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. The proposed selective riparian harvest, which would extend approximately 140 feet, is representative of approximately one-tenth of 1 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Due to the very limited spatial extent of the proposed action, a detailed analysis of potential effects to riparian function, such as described in Action Alternative B, will not be conducted in this section. Foreseeable adverse effects to riparian-type recruitable large woody debris and stream shading in Soup Creek are expected to be very minor if

Action Alternative C is implemented.

Proposed Unit 19 in Section 27, T24N, R17W, is also adjacent to Soup Creek. This unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

After an assessment of potential effects, which includes:

- an affected area equal to approximately one-tenth of 1 percent of the total riparian area adjacent bull trout or westslope cutthroat trout habitat,
- no foreseeable adverse effects to stand type (such as a shift in stand type),
- a relatively very minor reduction in potentially recruitable large woody debris, and
- an estimated very minor reduction in stream shading,

an overall very low risk of very low direct and indirect impacts to the riparian-function component of fish habitat are expected in Soup Creek.

As a result of implementing Action Alternative C, a moderate risk of low direct and indirect impacts to the riparian-function component of fisheries habitat are expected within Cilly and Unnamed creeks. A very low risk of very low direct and indirect impacts to the riparian-function component of fisheries habitat are expected within South Fork Lost and Soup creeks. The potential low and very low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Riparian Function***

*EXISTING CONDITIONS* describes low levels of direct and indirect impacts to the riparian function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

The proposed action associated with Action Alternative D that could further affect riparian function is selective riparian harvesting. Specific variables of riparian function that may be affected by the selective riparian harvest are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

Action Alternative D proposes a selective riparian harvest adjacent to approximately 2,950 feet of South Fork Lost Creek in proposed Unit 8 in Section 3, T24N, R17W. The location and extent of the proposed action is identical to that described in Action Alternative B. Proposed Unit 22 of Section 4, Unit 5 of Section 3, and Unit 3 of Section 1, all in T24N, R17W, are also adjacent to South Fork Lost Creek. These 3 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian functions of standtype composition, the quantity of recruitable large woody debris within the site potential tree height, and stream shading. As

a result of selecting Action Alternative D, effects to the riparian-function component of fish habitat in South Fork Lost Creek are expected to be the same as those described in the detailed analysis of riparian function in Action Alternative B. The results of that detailed analysis indicate an expected moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat in South Fork Lost Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

No proposed harvest units are adjacent to the fish-bearing reaches of Cilly and Unnamed creeks. A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 67 percent (7,260 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek and along approximately 68 percent (3,830 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not expected to have any adverse impacts to stand types (such as shifts in stand type) and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

Action Alternative D proposes a selective riparian harvest adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W ('Lower' Soup area), which lies entirely north of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. The proposed selective riparian harvest, which would extend approximately 2,480 feet, is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

Unit 19 in Section 27, T24N, R17W, is also adjacent to Soup Creek. This unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

Although Action Alternative D does not include Unit 11 in Section 27, T24N, R17W ('Lower' Soup area), which involves a selective harvest adjacent to approximately 140 feet of Soup Creek, the anticipated impacts of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the 'Lower' Soup area. The results of that detailed analysis indicate an expected overall moderate risk of low direct and indirect impacts to the riparian-function component of fish habitat in Soup Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

As a result of implementing Action Alternative D, a moderate risk of low direct and indirect impacts to the riparian-function component of fisheries habitat are expected within South Fork Lost, Cilly, Unnamed, and Soup creeks. The low expected

impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Riparian Function***

*EXISTING CONDITIONS* describes low levels of direct and indirect impacts to the riparian-function component of habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks. Low levels of existing impacts to South Fork Lost Creek are due to the proximity of the road corridor and consequent reduced recruitable large woody debris. Potential low existing impacts to Cilly, Unnamed, and Soup creeks are primarily due to general reduced recruitable large woody debris over the foreseeable near future.

The proposed action associated with Action Alternative E that could further affect riparian function is selective riparian harvesting. Specific variables of riparian function that may be affected by the selective riparian harvest are the compositions of stand types, the quantity of recruitable large woody debris within the riparian management zone, and stream shading.

Action Alternative E does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14 and 21 in Section 4 and Units 5 and 7 of Section 3, all in T24N, R17W, are adjacent to South Fork Lost Creek. These 4 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian functions of standtype composition, the quantity of recruitable large woody debris within the site potential tree height, and stream shading. As a result of selecting Action Alternative E, no foreseeable, or otherwise detectable, adverse direct and indirect impacts to the riparian function component of fish habitat are expected in South Fork Lost Creek.

Action Alternative E proposes a selective riparian harvest adjacent to approximately 1,380 combined feet of Cilly Creek in proposed Units 18 and 23 in Section 16, T24N, R17W, which spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 1,380 feet, is representative of approximately 7 percent of the total linear riparian area adjacent to the reaches of the stream that currently provides habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include potential moderately reduced levels of recruitable large woody debris and reduced levels of stream shading.

A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 49 percent (5,350 feet) of the upstream, perennial non-fish-bearing reach of Cilly Creek. This upstream harvest is expected to have no adverse impacts to stand types (such as shifts in stand type) and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, moderate reductions in stream shading may have a low impact to stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Cilly Creek, which includes:

- an affected area equal to approximately 7 percent of the total riparian area adjacent to eastern brook trout habitat,
- a potential moderate reduction in recruitable large woody debris to the fish-bearing reach,
- a potential moderate reduction in stream shading to the fish-bearing reach, and
- a potential moderate reduction in stream shading to the non-fish-bearing reach,

an overall low risk of low direct and indirect impacts to the riparian-function component of fish habitat is expected in that stream.

No proposed harvest units are adjacent to the fish-bearing reaches of Unnamed Creek. A selective riparian harvest, in accordance with the SMZ Law and Rules for Class 1 streams, would occur along approximately 12 percent (650 feet) of the upstream, perennial non-fish-bearing reach of Unnamed Creek. This upstream harvest is not expected to have adverse impacts to stand types and potentially recruitable large woody debris within the downstream fish-bearing reaches. However, minor reductions in stream shading may have a low impact on stream temperatures within the downstream fish-bearing reaches.

After an assessment of potential effects in Unnamed Creek, which includes a potential minor reduction in stream shading to the non-fish-bearing reach, an overall low risk of low direct and indirect impacts to the riparian-function component of fish habitat are expected in that stream.

Action Alternative E proposes a selective riparian harvest adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W ('Lower' Soup area), which lies entirely north of the stream channel. The proposed riparian harvest prescription includes a no-cut buffer from the nearest bankfull edge of Soup Creek to 25 feet, and a maximum harvest of 50 percent of trees 8 inches dbh or greater from 25 to 83 feet. The proposed selective riparian harvest, which would extend approximately 2,480 feet, is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout.

Unit 19 in Section 27 and Unit 10 in Section 26, T24N, R17W, are also adjacent to Soup Creek. These proposed units are located at least 100 feet from Soup Creek and are not expected to affect riparian functions.

Although Action Alternative E does not include proposed harvest Unit 11 in Section 27, T24N, R17W ('Lower' Soup area), which involves a selective harvest adjacent to approximately 140 feet of Soup Creek, the anticipated impacts of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the 'Lower' Soup area. The results of that detailed analysis indicate an expected overall moderate risk of low direct and indirect impacts to the riparian-function

component of fish habitat in Soup Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative E is selected for implementation.

As a result of implementing Action Alternative E, a moderate risk of low direct and indirect impacts to the riparian-function component of fisheries habitat are expected in Cilly, Unnamed, and Soup creeks, and a very low risk of very low direct and indirect impacts are expected in South Fork Lost Creek. The potential low and very low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- **Habitat - Large Woody Debris**

  - ***Direct and Indirect Effects of No-Action Alternative A to Habitat - Large Woody Debris***

    No direct or indirect impacts to the bull trout, westslope cutthroat trout, or other fisheries habitat component of large woody debris would occur in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

  - ***Direct and Indirect Effects of Action Alternative B to Habitat - Large Woody Debris***

    *EXISTING CONDITIONS* describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

    The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvesting is the frequency of in-stream large woody debris.

    The assessment of riparian function noted that reduced levels of recruitable large woody debris is expected from approximately 3 percent of the total riparian area adjacent to the fish-bearing reaches of South Fork Lost Creek and approximately 6 percent of the total riparian area adjacent to the fish-bearing reaches of Soup Creek. Furthermore, the actual levels of reduced recruitable large woody debris from the riparian areas adjacent to proposed harvest units are expected to be relatively minor compared to *EXISTING CONDITIONS*. And a simple assessment of index trees at least 100 years old (adjacent to the proposed harvest areas) suggests instantaneous recruitment rates of this tree size class may be reduced by approximately 3 percent in the South Fork Lost Creek proposed harvest unit and 4 to 6 percent in the Soup Creek proposed harvest units. Considering this outcome only, a proportional long-term decrease may occur in in-stream large woody debris, but frequency levels are expected to remain within the ranges of the frequencies found in nearby undisturbed reference reaches (see *EXISTING CONDITIONS*).

    On the contrary, large-woody-debris recruitment to South Fork Lost and Soup creeks through windthrow and windsnap is likely to increase some degree after implementing the proposed riparian harvest prescriptions. This event is likely to occur

since prevailing storm winds are typically able to have a greater impact on windthrow and windsnap within riparian buffers when relatively more intensive and adjacent upland harvesting is implemented. The riparian soil conditions adjacent to South Fork Lost and Soup creeks are also conducive to higher levels of windthrow. Considering this outcome only, higher levels of windthrow and windsnap as a result of adjacent timber harvesting are expected to lead to short-term increases in the frequency of in-stream large woody debris to South Fork Lost and Soup creeks.

A large-woody-debris recruitment model (*Welty et al 2002*) also indicates that higher levels of in-stream large woody debris in South Fork Lost and Soup creeks may result for at least 100 years after implementing the proposed riparian harvest prescriptions. Model results are not easily quantified since the default stand-growth equations are developed for the western Cascades region, and to develop and program project-specific stand-growth equations for the model inputs is beyond the scope of this portion of this analysis. However, after applying the proposed riparian harvest prescriptions, the default outputs are likely representative of a general trend in large-woody-debris recruitment (and not necessarily the future rates of large-woody-debris recruitment). The potential increased trend in large-woody-debris recruitment is likely due to model assumptions such as an anticipated increase in windthrow and windsnap and stand regeneration within the selective riparian harvest area that may supersede the existing late-seral stocking levels.

No adverse impacts to the large-woody-debris component of fish habitat are anticipated in Cilly and Unnamed creeks, since no riparian harvesting is expected adjacent to the fish-bearing reaches of these streams. Primarily due to the relatively small channel sizes, migration of in-stream large woody debris to the fish-bearing reaches from upstream non-fish-bearing reaches (where riparian harvesting would occur) is not expected to be affected.

As a result of implementing Action Alternative B, a low risk of very low direct and indirect impacts to the large-woody-debris component of fisheries habitat within South Fork Lost and Soup creeks are expected. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected within Cilly and Unnamed creeks. The low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if Action Alternative B is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative C to Habitat – Large Woody Debris***

*EXISTING CONDITIONS* describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying

the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvest is the frequency of in-stream large woody debris.

Action Alternative C does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14, 15, 19, 20, and 22 in Section 4 and Unit 5 in Section 3, all in T24N, R17W, are near South Fork Lost Creek. These 6 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian function of providing recruitable large woody debris within the site potential tree height. As a result of selecting Action Alternative C, no foreseeable adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat in South Fork Lost Creek are expected.

Action Alternative C proposes a selective riparian harvest adjacent to approximately 650 feet of Cilly Creek in proposed Unit 23 in Section 16, T24N, R17W; that harvest spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet, in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 650 feet, is representative of approximately 3 percent of the total linear riparian area adjacent to the reaches of the stream that currently provide habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include reduced levels of recruitable large woody debris. A low risk of low direct and indirect impacts to the in-stream large-woody-debris component of fisheries habitat in Cilly Creek is also expected as a result of implementing Action Alternative C.

Action Alternative C does not propose any selective riparian harvesting adjacent to fish-bearing reaches of Unnamed Creek. As a result of selecting Action Alternative C, no foreseeable adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are expected in Unnamed Creek.

Action Alternative C proposes selective riparian harvesting adjacent to approximately 140 combined feet of Soup Creek in proposed Unit 11 of Section 27, T24, R17W ('Lower' Soup area). The proposed selective riparian harvest is representative of approximately one-tenth of 1 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Foreseeable adverse impacts to recruitable large woody debris in Soup Creek are expected to be very minor if Action Alternative C is implemented. A comparable, or very low risk of very direct and indirect impacts, to in-stream large woody debris in Soup Creek is also expected as a result of implementing Action Alternative C.

As a result of implementing Action Alternative C, a low risk of low direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in Cilly Creek, and a very low risk of very low direct and indirect impacts are expected in Soup

Creek. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in South Fork Lost and Unnamed creeks. The expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative D to Habitat – Large Woody Debris***

*EXISTING CONDITIONS* describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvest is the frequency of in-stream large woody debris.

Action Alternative D proposes selective riparian harvesting adjacent to approximately 2,950 feet of South Fork Lost Creek in proposed Unit 8 in Section 3, T24N, R17W. The location and extent of the proposed action is identical to that described in Action Alternative B. Unit 22 in Section 4, Unit 5 in Section 3, and Unit 3 in Section 1, all in T24N, R17W, are also adjacent to South Fork Lost Creek. These 3 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian function of providing recruitable large woody debris. The spatial extent of anticipated selective riparian harvesting in Action Alternative D is similar or less than that proposed under Action Alternative B. The degree of anticipated selective riparian harvesting in Action Alternative D is also expected to be similar. As a result of selecting Action Alternative D, the potential overall direct and indirect effects to the large-woody-debris component of fisheries habitat within the project area are expected to be the same as those described for Action Alternative B.

No harvest units are proposed adjacent to the fish-bearing reaches of Cilly and Unnamed creeks. As a result of selecting Action Alternative D, foreseeable adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are not expected in Cilly and Unnamed creeks.

Action Alternative D proposes a selective riparian harvest adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W ('Lower' Soup area), which lies entirely north of the stream channel. The proposed selective riparian harvest would extend approximately 2,480 feet and is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Proposed Unit 19 in Section 27, T24N, R17W, is also adjacent to Soup Creek. This proposed unit is located at least 120 feet from Soup Creek and is not expected to affect riparian functions.

Although Action Alternative D does not include proposed Unit 11 in Section 27, T24N, R17W ('Lower' Soup area), which involves selective riparian

harvesting adjacent to approximately 140 feet of Soup Creek, the anticipated effects of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the 'Lower' Soup area. The degree of anticipated selective riparian harvest in Action Alternative D is also expected to be similar. As a result of selecting Action Alternative D, the potential overall direct and indirect effects to the large-woody-debris component of fisheries habitat within the project area are expected to be the same as those described for Action Alternative B.

As a result of implementing Action Alternative D, a low risk of very low direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in South Fork Lost and Soup creeks. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in Cilly and Unnamed creeks. The low impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in South Fork Lost and Soup creeks as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E to Habitat – Large Woody Debris***

*EXISTING CONDITIONS* describes no apparent direct and indirect impacts to the large-woody-debris component of fisheries habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks.

The proposed action associated with this alternative that may affect in-stream large woody debris is selective riparian harvesting. Selective riparian harvesting may affect in-stream large woody debris by modifying the amounts of potentially recruitable large woody debris and modifying existing patterns of windthrow and windsnap. A specific variable of large woody debris that may be affected by the selective riparian harvest is the frequency of in-stream large woody debris.

Action Alternative E does not propose any selective riparian harvesting adjacent to South Fork Lost Creek. Proposed Units 14 and 21 in Section 4 and Units 5 and 7 in Section 3, all in T24N, R17W, are near South Fork Lost Creek. These 4 units are located at least 140 feet from South Fork Lost Creek and are not expected to affect the riparian function of providing recruitable large woody debris within the site potential tree height. As a result of selecting Action Alternative E, no foreseeable, adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are expected in South Fork Lost Creek.

Action Alternative E proposes selective riparian harvesting adjacent to approximately 1,380 combined feet of Cilly Creek in proposed Units 18 and 23 in Section 16, T24N, R17W, which spans both sides of the stream channel. The proposed riparian harvest prescription includes the establishment of the RMZ at 91 feet in accordance with *ARM 36.11.425(5)* and implementation of the SMZ Law and Rules for Class 1 streams. The proposed selective riparian harvest, which would extend approximately 1,380 feet, is representative of

approximately 7 percent of the total linear riparian area adjacent to the reaches of the stream that currently provide habitat to eastern brook trout. Expected impacts to the fish-bearing reach of Cilly Creek over the foreseeable near future include reduced levels of recruitable large woody debris. A moderate risk of low direct and indirect impacts to in-stream large woody debris in Cilly Creek is also expected as a result of implementing Action Alternative E.

Action Alternative E does not propose any selective riparian harvesting adjacent to the fish-bearing reaches of Unnamed Creek. As a result of selecting Action Alternative E, no foreseeable, adverse direct and indirect impacts to the in-stream large-woody-debris component of fish habitat are expected in Unnamed Creek.

Action Alternative E proposes selective riparian harvesting adjacent to approximately 2,480 feet of Soup Creek in proposed Unit 5 in Section 27, T24N, R17W ('Lower' Soup area), which lies entirely north of the stream channel. The proposed selective riparian harvest, which would extend approximately 2,480 feet, is representative of approximately 2 percent of the total linear riparian area adjacent to the reaches of the stream that provide habitat to bull trout or westslope cutthroat trout. Unit 19 in Section 27 and Unit 10 in Section 26, all in T24N, R17W, are also adjacent to Soup Creek. These proposed units are located at least 100 feet from Soup Creek and are not expected to affect riparian functions.

Although Action Alternative E does not include proposed Unit 11 in Section 27, T24N, R17W ('Lower' Soup area), which involves selective riparian harvesting adjacent to approximately 140 feet of Soup Creek, the anticipated effects of the selective riparian harvest are expected to be the same as the results of the detailed analysis in Action Alternative B for the 'Lower' Soup area. The degree of anticipated selective riparian harvest in Action Alternative E is also expected to be similar. As a result of selecting Action Alternative E, the potential overall direct and indirect effects to the large-woody-debris component of fisheries habitat within the project area are expected to be the same as those described for Action Alternative B.

As a result of implementing Action Alternative E, a moderate risk of low direct and indirect impacts to the large-woody-debris component of fisheries habitat is expected in Cilly Creek, and a low risk of very direct and indirect impacts is expected in Soup Creek. No direct and indirect impacts to the large-woody-debris component of fisheries habitat are expected in South Fork Lost and Unnamed creeks. The expected impacts are above and beyond those described for this habitat component in *EXISTING CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested in Soup Creek as part of future monitoring if Action Alternative E is selected for implementation.

Habitat - Stream Temperature

- ***Direct and Indirect Effects of Action No-Alternative A on Habitat – Stream Temperature***

  No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat components of stream temperature in South Fork Lost, Cilly, Unnamed, or Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B on Habitat – Stream Temperature***

  *EXISTING CONDITIONS* describes no apparent direct and indirect impacts to the stream-temperature component of habitat in South Fork Lost, Cilly, and Unnamed creeks. Potential existing direct and indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habit may be low in Reach 1 of Soup Creek. No existing direct or indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat are apparent in Reaches 2, 3, and 4 of Soup Creek. Whether the potential low existing direct and indirect impacts in Reach 1 of Soup Creek are from natural conditions or land-management practices is uncertain.

  The primary proposed action associated with this alternative that could adversely affect stream temperature is selective riparian harvesting. Stream temperature may be affected by the proposed selective riparian harvest through decreases in angular canopy density (shade), sedimentation from increase rates of wind-thrown root wads, sedimentation from soil disturbances adjacent to riparian areas, and sedimentation from road stream-crossing installations. Sedimentation may directly or indirectly contribute to increases in stream temperature through the aggradations of pool (slow) stream features. The aggradations of pool (slow) stream features may promote increases in stream width-to-depth ratios, which may, consequently, decrease the capacity of a stream to resist changes in temperature. Potential changes in stream temperature are evaluated by assessing the anticipated change in temperature at the reach scale.

  Changes in stream temperature in South Fork Lost Creek adjacent to the proposed selective riparian harvest are an issue that will be further analyzed below. Potential impacts to this fisheries-habitat variable in South Fork Lost Creek are likely to be more pronounced than in other fish-bearing streams due to the extent of the proposed selective riparian harvesting that may occur south of the stream.

  Moderate levels of selective riparian harvesting are expected to occur in non-fish-bearing reaches of Cilly and Unnamed creeks. These moderate levels of riparian harvesting are expected to have a moderate risk of adverse effects to stream shading in the non-fish-bearing reaches and a consequent low impact to stream temperatures. However, due to disconnected surface flows and known interactions with groundwater sources, the low impact to stream temperatures in the non-fish-bearing reaches of Cilly and Unnamed creeks are also expected to have a low risk of low direct and indirect impacts to the stream-temperature

component of fish habitat in downstream reaches.

Virtually all of the proposed adjacent selective riparian harvesting would occur on the north side of Soup Creek, which is expected to reduce angular canopy closure (shading) during peak temperatures by an estimated 5 percent. As a result of the minor reduction in shading, a very low risk of very low direct and indirect impacts to the stream-temperature component of fish habitat in Soup Creek is expected.

Two widely acknowledged models are utilized to analyze potential changes to stream temperature in South Fork Lost Creek as a result of modifications to angular canopy density (shade). The first model, SSTEMP (*Bartholow 2002*), considers a myriad of stream and riparian variables, including stream input temperatures, hydrology, stream geometry, meteorology, percent shade, other shade factors, and time of year. The second model, described in *Currier and Hughes (1980)* and *Beschta et al (1987)*, is based on a simple relationship between net rate of heat added to the stream, surface area of the stream exposed to solar radiation, and streamflow.

In order to evaluate the potential change in stream temperature through SSTEMP, the proposed selective riparian harvest prescription will be applied to known stream and riparian variables during the peak stream-temperature periods of 2004 and 2005. The initial stream-temperature inputs are those recorded at the 'SFKLost#2_Middle' station (South Fork Lost Creek) since these are the approximate locations of the adjacent, upstream extent of the proposed selective riparian harvest. The estimated reduction in angular canopy closure for South Fork Lost Creek (20 percent) will be used in this model. Weather archives available for Bigfork, Montana (approximately 19 miles northwest of South Fork Lost Creek) will be used for meteorological inputs. (A total of 34 stream and riparian variables are input to the SSTEMP model and a total of 22 stream and riparian variables are input to the *Currier and Hughes [1980]* and *Beschta et al [1987]* model, most of which are derived from field measurements.) The SSTEMP model outputs will estimate the change in stream temperature through the portion of South Fork Lost Creek that is immediately adjacent to the proposed selective riparian harvest (see *TABLE E-37 - ESTIMATIONS OF CHANGE IN STREAM TEMPERTURE ADJACENT TO THE PROPOSED SELECTIVE RIPARIAN HARVEST ALONG SOUTH FORK LOST CREEK*). By using the known stream and riparian variables from 2004 and 2005, the outputs will reflect the predicted average changes in stream temperatures if the proposed selective riparian harvest had occurred during those years.

The potential change in stream temperature as predicted by *Currier and Hughes (1980)* and *Beschta et al (1987)* will also be displayed in *TABLE E-37 - ESTIMATIONS OF CHANGE IN STREAM TEMPERATURE ADJACENT TO THE PROPOSED SELECTIVE RIPARIAN HARVEST ALONG SOUTH FORK LOST CREEK*. These potential changes in stream temperature reflect estimated maximum changes in temperature during late July, immediately following the implementation of the proposed selective riparian harvest prescription. The estimated reductions in angular canopy

*TABLE E-37 - ESTIMATIONS OF CHANGE IN STREAM TEMPERATURE ADJACENT TO THE PROPOSED SELECTIVE RIPARIAN HARVEST ALONG SOUTH FORK LOST CREEK*

| | STREAM | | |
|---|---|---|---|
| | SOUTH FORK LOST CREEK 2004 | SOUTH FORK LOST CREEK 2005 | SOUTH FORK LOST CREEK EXISTING |
| Estimated total linear distance (feet) of selective riparian harvest adjacent to fish-bearing reaches | 2,950 | 2,950 | 2,950 |
| Model | SSTEMP | SSTEMP | C and H, B* |
| Actual change in stream temperature (degrees) (maximum weekly maximum temperature [Celsius]) | +0.2 | +0.2 | N/A to model |
| Predicted change in stream temperature (degrees) as a result of implementing selective riparian harvest (Celsius) | +0.5 | +0.5 | +0.4 |

**Currier and Hughes (1980) and Beschta et al (1987)*

closure for South Fork Lost Creek (20 percent) will be used in this model.

The predicted changes in stream temperature in South Fork Lost Creek adjacent to the proposed riparian harvest range from +0.4 to +0.5 degrees Celsius. The predicted stream temperature changes developed by SSTEMP for both 2004 and 2005 are +0.3 degrees Celsius above the actual observed changes in stream temperature. The predicted stream temperature change developed by *Currier and Hughes (1980)* and *Beschta et al (1987)* is +0.2 degrees Celsius greater than the actual observed changes in both 2004 and 2005. The predicted changes in stream temperature are expected to be relatively minor and representative of a moderate risk of low direct and indirect impacts to the stream-temperature component of fish habitat in South Fork Lost Creek.

As indicated in the risk assessment for sediment, a low risk of low impacts to the sediment component of fisheries habitat is expected in South Fork Lost, Cilly, and Soup creeks, and a moderate risk of moderate impacts is expected in Unnamed Creek. A proportional, or overall low risk of low impacts is expected to the channel forms in South Fork Lost, Cilly, and Soup creeks, and a moderate risk of low impacts is expected in Unnamed Creek. As described above, the aggradations of pool (slow) stream features may promote increases in stream width-to-depth ratios, which may consequently decrease the capacity of a stream to resist changes in temperature. Because of this potential chain of events related to sedimentation and possible shifts in channel forms, a risk of adverse impacts to the stream-temperature component of fish habitat is expected in the project area.

As a result of implementing Action Alternative B, an overall low risk of low direct and indirect impacts to the stream-temperature component of fisheries habitat is expected in South Fork Lost, Cilly, and Soup creeks. A moderate risk of low direct and indirect impacts is expected in Unnamed Creek. The low impact is above and beyond those described for this habitat component in *EXISTING*

*CONDITIONS*. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative B is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative C on Habitat – Stream Temperature***

  The overall anticipated direct and indirect impacts to the stream-temperature component of fish habitat in South Fork Lost, Cilly, Unnamed, and Soup creeks are expected to be similar or less than those described in Action Alternative B. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative C is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative D on Habitat – Stream Temperature***

  The overall anticipated direct and indirect impacts to the stream- temperature component of fish habitat are expected to be similar or less than those described in Action Alternative B, except a moderate risk of low direct and indirect impacts is expected in Cilly and Unnamed creeks. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative D is selected for implementation.

- ***Direct and Indirect Effects of Action Alternative E on Habitat – Stream Temperature***

  The overall anticipated direct and indirect impacts to the stream- temperature component of fish habitat are expected to be similar or less than those described in Action Alternative B, except a low risk of low direct and indirect impacts is expected in Unnamed Creek. The assumptions derived from this portion of the project analysis are expected to be reevaluated and tested as part of future monitoring if Action Alternative E is selected for implementation.

♦ HABITAT – CONNECTIVITY

- ***Direct and Indirect Effects of No-Action Alternative A on Habitat – Connectivity***

  No direct or indirect impacts would occur to the bull trout, westslope cutthroat trout, or other fisheries habitat component of connectivity in South Fork Lost, Cilly, Unnamed, and Soup creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B on Habitat – Connectivity***

  *EXISTING CONDITIONS* describes no direct and indirect impacts to the connectivity component of fisheries habitat in South Fork Lost and Soup creeks within the project area. Existing direct and indirect impacts to the connectivity component of fisheries habitat in Cilly Creek are likely low and in Unnamed Creek are likely moderate to high.

  Two existing, failing bridge crossings of South Fork Lost Creek within the project area would be fully removed as part of Action Alternative B; these crossings are located in the NW1/4SW1/4 of Section 4 and the NW1/4SE1/4 of Section 2, all in T24N, R17W. Three existing, failing bridge crossings of Soup Creek within and immediately adjacent to the project area would also be fully removed as part of Action Alternative B; these crossings are located in the NE1/4NW1/4 of Section 29, NW1/4NW1/4 of Section 25, and

SE1/4NE1/4 of Section 25, all in T24N, R17W. One other existing, failing bridge crossing of Soup Creek would be replaced with a new bridge; this crossing is located in the NE1/4NE1/4 of Section 26, T24N, R17W. The new bridge structure and 5 bridge reclamation sites on South Fork Lost Creek and Soup Creek are expected to provide naturally occurring levels of connectivity to all life stages of native and nonnative fish species.

Existing direct and indirect impacts to the connectivity component of fisheries habitat in Cilly and Unnamed creeks would not be remediated as part of Action Alternative B.

As a result of the selection of Action Alternative B, no adverse direct or indirect impacts to the fisheries habitat variable of connectivity in South Fork Lost, Cilly, Unnamed, and Soup creeks would occur beyond those described in *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternatives C, D, and E on Habitat – Connectivity***

  In terms of fisheries connectivity, the associated proposed actions in Action Alternative B are also expected to occur if Action Alternatives C, D, or E is selected. As a result of the selection of one of these alternatives, the anticipated risk of direct and indirect impacts to the fisheries habitat variable of connectivity in South Fork Lost, Cilly, Unnamed, and Soup creeks are expected to be the same as those described for Action Alternative B.

*CUMULATIVE EFFECTS*

Cumulative impacts are those collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (*75-1-220, MCA*). Future actions include State-sponsored actions that are under concurrent consideration by any State agency through the environmental-analysis or permit-processing procedures. The potential cumulative effects to fisheries in the Three Creeks Timber Sale Project area are determined by assessing the collective anticipated direct and indirect impacts, other related existing actions, and future actions affecting the fish-bearing streams in the project area. In order to help convey a summary of potential cumulative impacts, a matrix of anticipated impacts to fisheries in the project area is displayed in *TABLE E-38 - MATRIX OF COLLECTIVE DIRECT, INDIRCT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF NO-ACTION ALTERNATIVE A* and *TABLE E-39 (THROUGH E-42) - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE B, (C, D, AND E)*.

- ***Cumulative Effects of No-Action Alternative A to Fisheries***

  In order to correctly interpret the potential for cumulative impacts in this fisheries analysis, the anticipated cumulative impact to a specific stream is relative to the existing conditions. For instance, there is likely a 'moderate' level of existing collective impacts to fisheries in South Fork Lost Creek (see *EXISTING CONDITIONS*). As a result of the selection of No-Action Alternative A, a potential 'very low to low' level of cumulative impacts that may occur

in addition to the 'moderate' level of existing collective impacts to fisheries that currently exist.

Other related actions that are considered in the existing cumulative impacts are low impacts to South Fork Lost and Soup creeks due to existing adjacent road use by recreational vehicles, low impacts to South Fork Lost and Soup creeks due to recreational fishing, and low impacts to South Fork Lost and Cilly creeks due to historic riparian harvesting on other land ownerships in the project area.

No future actions have been identified for consideration in the South Fork Lost Creek and Soup Creek drainages.

Two future actions that have been identified for consideration in the Cilly Creek drainage are the Cilly Bug Salvage Timber Sale Project and Red Ridge Salvage Permit. The Cilly Bug Salvage Timber Sale Project is expected to include a riparian harvest through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 1,800 feet adjacent to the north side of the non-fish-bearing reach of Cilly Creek. The only fish habitat variable in the downstream fish-bearing reach of Cilly Creek that may be affected by the action is stream temperature. As a result of this action, potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are very low. The Red Ridge Salvage Permit proposes to harvest timber from approximately 30 acres in the Cilly Creek watershed. The proposed timber harvest would take place approximately 0.5 miles from Cilly Creek, and road use associated with the timber harvest is not expected to have any adverse impacts to Cilly Creek. As a result of this action, no potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are expected.

The Red Ridge Salvage Permit has been identified as a future action for consideration in the Unnamed Creek drainage. This permit proposes to harvest timber from approximately 60 acres in the Unnamed Creek watershed. The permit is expected to include riparian harvesting through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 700 feet adjacent to the northeast side of the fish-bearing reach of Unnamed Creek. Stream temperature is the only fish habitat variable in the downstream fish-bearing reach of Unnamed Creek that may be affected by the action. As a result of this action, the potential direct and indirect impacts to the stream-temperature component of fish habitat in Unnamed Creek are very low.

The determination of cumulative impacts in this fisheries analysis is based on an assessment of all variables. As a result of these considerations, determinations of foreseeable cumulative impacts in this analysis are primarily a consequence of other related actions and future actions.

As a result of the selection of No-Action Alternative A, cumulative impacts to fisheries in South Fork Lost, Cilly, Unnamed, and Soup creeks are expected to be very low to low beyond those impacts described in *EXISTING CONDITIONS*.

*TABLE E-38 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF NO-ACTION ALTERNATIVE A*

| | SOUTH FORK LOST CREEK | CILLY CREEK | UNNAMED CREEK | SOUP CREEK |
|---|---|---|---|---|
| Presence and genetics | None | None | None | None |
| Flow regimes | None | None | None | None |
| Sediment | None | None | None | None |
| Channel forms | None | None | None | None |
| Riparian function | None | None | None | None |
| Large woody debris | None | None | None | None |
| Stream temperature | None | None | None | None |
| Connectivity | None | None | None | None |
| Other related actions | Low | Low | None | Low |
| Future actions | None | Very low | Very low | None |
| Cumulative effects | Very low to low | Very low to low | Very low | Very low to low |

- ***Cumulative Effects of Action Alternative B on Fisheries***

In order to correctly interpret the potential for cumulative impacts in this analysis, the anticipated cumulative impact to a specific stream is relative to *EXISTING CONDITIONS*. For instance, the level of existing collective impacts to fisheries in South Fork Lost Creek is likely 'moderate' (see *EXISTING CONDITIONS*). As a result of the selection of Action Alternative B, a potential 'low' level of cumulative impacts may occur in addition to the 'moderate' level of existing collective effects to fisheries that currently exist.

Other related actions that are considered in the existing cumulative impacts are a low impact to South Fork Lost and Soup creeks due to existing adjacent road use by recreational vehicles, a low impact to South Fork Lost and Soup creeks due to recreational fishing, and a low impact to South Fork Lost and Cilly creeks due to historic riparian harvesting on other land ownerships in the project area.

No future actions have been identified for consideration in the South Fork Lost Creek and Soup Creek drainages.

Two future actions that have been identified for consideration in the Cilly Creek drainage are the Cilly Bug Salvage Timber Sale Project and Red Ridge Salvage Permit. The Cilly Bug Salvage Timber Sale Project is expected to include a riparian harvest through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 1,800 feet adjacent to the north side of the non-fish-bearing reach of Cilly Creek. The only fish habitat variable in the downstream fish-bearing reach of Cilly Creek that may be affected by the action is stream temperature. As a result of this action, potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are very low. The Red Ridge Salvage Permit proposes to harvest timber from approximately 30 acres in the Cilly Creek watershed. The proposed timber harvest would take place approximately 0.5 miles from Cilly Creek, and road use associated with the timber harvest is not expected to have any adverse impacts to Cilly Creek. As a result of this action, no potential direct and indirect impacts to the stream temperature component of fish habitat in Cilly Creek are expected.

The Red Ridge Salvage Permit has been identified as a future action

for consideration in the Unnamed Creek drainage. This permit proposes to harvest timber from approximately 60 acres in the Unnamed Creek watershed, and is expected to include riparian harvesting through the application of the SMZ Law and Rules (*ARM 36.11.301*). The linear extent of the riparian harvest is expected to be approximately 700 feet adjacent to the northeast side of the fish-bearing reach of Unnamed Creek. Stream temperature is the only fish habitat variable in the downstream fish-bearing reach of Unnamed Creek that may be affected by the action. As a result of this action, potential direct and indirect impacts to the stream temperature component of fish habitat in Unnamed Creek are very low.

The determination of cumulative effects in this fisheries analysis is based on an assessment of all variables, but the variables are not weighted equally in making the determination. Anticipated impacts from sedimentation and connectivity tend to have a greater level of risk to fisheries than the anticipated impacts from flow regimes and riparian function. As a result of these considerations, determinations of foreseeable cumulative impacts in this analysis are primarily a consequence of potential sedimentation from various sources, such as flow regime, potential riparian soil disturbance, and windthrown root wads.

As a result of the selection of Action Alternative B, an overall moderate risk of low cumulative impacts to fisheries is expected in South Fork Lost, Cilly, and Soup creeks beyond those impacts described in *EXISTING CONDITIONS*. An overall moderate risk of a moderate cumulative impact is expected to fisheries in Unnamed Creek. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative B.

***TABLE E- 39 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE B***

| | **SOUTH FORK LOST CREEK** | **CILLY CREEK** | **UNNAMED CREEK** | **SOUP CREEK** |
|---|---|---|---|---|
| Presence and genetics | None | None | None | None |
| Flow regimes | Very Low | Low | Low | Very Low |
| Sediment | Low | Low | Moderate | Low |
| Channel forms | Low | Low | Low | Low |
| Riparian function | Low | Low | Low | Low |
| Large woody debris | Very Low | None | None | Very Low |
| Stream temperature | Low | Low | Low | Low |
| Connectivity | None | None | None | None |
| Other related actions | Low | Low | None | Low |
| Future actions | None | Very Low | Very Low | None |
| *Cumulative effects* | *Low* | *Low* | *Moderate* | *Low* |

- ***Cumulative Effects of Action Alternative C to Fisheries***

The assessment of potential cumulative effects follows the same methodology described in Action Alternative B. Other related future actions are also expected to be the same as those described in Action Alternative B. In order to help convey a summary of potential cumulative impacts as a result of implementing Action Alternative C, a matrix of anticipated effects to fisheries in the project area is displayed in *TABLE-40 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMUILATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE C.*

As a result of the selection of Action Alternative C, an overall moderate risk of low cumulative impacts to fisheries is expected in South Fork Lost, Cilly, and Soup creeks beyond those impacts described in *EXISTING CONDITIONS*. An overall moderate risk of a moderate cumulative impact is expected to fisheries in Unnamed Creek. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative C.

***TABLE E-40 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE C***

| | **SOUTH FORK LOST CREEK** | **CILLY CREEK** | **UNNAMED CREEK** | **SOUP CREEK** |
|---|---|---|---|---|
| Presence and genetics | None | None | None | None |
| Flow regimes | Very low | Low | Low | Very low |
| Sediment | Low | Low | Moderate | Low |
| Channel forms | Low | Low | Low | Low |
| Riparian function | Very low | Low | Low | Very low |
| Large woody debris | None | Low | None | Very low |
| Stream temperature | Low | Low | Low | Low |
| Connectivity | None | None | None | None |
| Other related actions | Low | Low | None | Low |
| Future actions | None | Very low | Very low | None |
| *Cumulative effects* | *Low* | *Low* | *Moderate* | *Low* |

- ***Cumulative Effects of Action Alternative D to Fisheries***

The assessment of potential cumulative effects follows the same methodology described in Action Alternative B. Other related future actions are also expected to be the same as those described in Action Alternative B. In order to help convey a summary of potential cumulative impacts as a result of implementing Action Alternative D, a matrix of anticipated effects to fisheries in the project area is displayed in *TABLE-41 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE D.*

As a result of the selection of Action Alternative D, an overall moderate risk of low cumulative impacts to fisheries is expected in South Fork Lost and Soup creeks beyond those impacts described in *EXISTING CONDITIONS*. An overall moderate risk of a moderate cumulative impact is expected to fisheries in Cilly and Unnamed creeks. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative D.

***TABLE E-41 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE D***

| | **SOUTH FORK LOST CREEK** | **CILLY CREEK** | **UNNAMED CREEK** | **SOUP CREEK** |
|---|---|---|---|---|
| Presence and genetics | None | None | None | None |
| Flow regimes | Very low | Low | Low | Very low |
| Sediment | Low | Moderate | Moderate | Low |
| Channel forms | Low | Low | Low | Low |
| Riparian function | Very low | Low | Low | Very low |
| Large woody debris | Low | None | None | Low |
| Stream temperature | Low | Low | Low | Low |
| Connectivity | None | None | None | None |
| Other related actions | Low | Low | None | Low |
| Future actions | None | Very low | Very low | None |
| *Cumulative effects* | *Low* | *Moderate* | *Moderate* | *Low* |

- ***Cumulative Effects of Action Alternative E to Fisheries***

The assessment of potential cumulative effects follows the same methodology described in Action Alternative B. Other related future actions are also expected to be the same as those described in Action Alternative B. In order to help convey a summary of potential cumulative impacts as a result of implementing Action Alternative E, a matrix of anticipated effects to fisheries in the project area is displayed in *TABLE-42 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE E.*

As a result of the selection of Action Alternative E, an overall moderate risk of a low cumulative impact to fisheries is expected in the South Fork Lost Creek, Cilly Creek, Unnamed Creek, and Soup creeks are expected to be low beyond those impacts described in the Existing Conditions. No measurable or otherwise detectable cumulative impacts are expected to fisheries in downstream reaches of Swan River and Lost Creek as a result of implementing Action Alterative E.

***TABLE E-42 - MATRIX OF COLLECTIVE DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FISHERIES IN THE THREE CREEKS TIMBER SALE PROJECT AREA AS A RESULT OF THE SELECTION OF ACTION ALTERNATIVE E***

| | **SOUTH FORK LOST CREEK** | **CILLY CREEK** | **UNNAMED CREEK** | **SOUP CREEK** |
|---|---|---|---|---|
| Presence and genetics | None | None | None | None |
| Flow regimes | Very low | Low | Very low | Very low |
| Sediment | Low | Low | Low | Low |
| Channel forms | Low | Low | Low | Low |
| Riparian function | Very low | Low | Low | Low |
| Large woody debris | None | Low | None | Very low |
| Stream temperature | Low | Low | Low | Low |
| Connectivity | None | None | None | None |
| Other related actions | Low | Low | None | Low |
| Future actions | None | Very low | Very low | None |
| *Cumulative effects* | *Low* | *Low* | *Low* | *Low* |

## SPECIALIST RECOMMENDATIONS

- **POPULATIONS - PRESENCE AND GENETICS**

  No recommendations

- **HABITAT - FLOW REGIMES**

  No recommendations

- **HABITAT - SEDIMENT and CHANNEL FORMS**

  - Apply all applicable Forestry BMPs (including the SMZ Law and Rules) and Forest Management Administrative Rules for soils riparian management zones.
  - Monitor all road stream crossings for sedimentation and deterioration of road prism.
  - Only allow equipment traffic at road stream crossings when road prisms have adequate load-bearing capacity.

- **HABITAT - RIPARIAN FUNCTION, LARGE WOODY DEBRIS, AND STREAM TEMPERATURE**

  - Apply all applicable BMPs (including SMZ Law and Rules) and Forest Management Administrative Rules for fisheries riparian management zones to fish-bearing streams in the project area.
  - South Fork Lost Creek

    Immediately adjacent to proposed harvest units, establish the outside edge of the fisheries riparian management zone at 95 feet from the nearest bankfull edge of the stream channel. Within the fisheries riparian management zone provide adequate large-woody-debris recruitment and stream shading by (1) creating a no-cut buffer from the nearest bankfull edge of the stream channel to 25 feet, and (2) harvesting a maximum of 50 percent of trees greater than 8 inches in diameter at breast height from 25 to 95 feet.
  - Cilly Creek

    Immediately adjacent to proposed harvest units, establish the outside edge of the fisheries riparian management zone at 91 feet from the nearest bankfull edge of the stream channel. Within the fisheries riparian management zone, provide adequate large-woody-debris recruitment and stream shading by implementing the SMZ Law and Rules for Class 1 streams.
  - Soup Creek

    Immediately adjacent to proposed harvest units, establish the outside edge of the fisheries riparian management zone at 83 feet from the nearest bankfull edge of the stream channel. Within the fisheries riparian management zone provide adequate large-woody-debris recruitment and stream shading by (1) creating a no-cut buffer from the nearest bankfull edge of the stream channel out to 25 feet and (2) harvesting a maximum of 50 percent of trees greater than 8 inches in diameter at breast height from 25 to 83 feet.
  - Apply the SMZ Law and Rules to all non-fish-bearing streams in the project area.

- **HABITAT - CONNECTIVITY**

  No recommendations

- **CUMULATIVE IMPACTS**

  No recommendations

## SUMMARY OF ANTICIPATED PROJECT-LEVEL MONITORING IF AN ACTION ALTERNATIVE IS SELECTED

- Bull trout, and, in some cases, westslope cutthroat trout, population monitoring through annual redd counts.
- McNeil core and substrate score monitoring in bull trout spawning reaches in South Fork Lost and Soup creeks.
- Fish habitat monitoring, such as repeat R1/R4 surveying, in South Fork Lost and Soup creeks.
- Riparian stand characteristics (quadratic mean diameter, trees per acre, basal area) monitoring in proposed selective riparian-harvest areas adjacent to South Fork Lost and Soup creeks.
- Angular canopy density (shade) monitoring in South Fork Lost and Soup creeks adjacent to proposed selective riparian-harvest areas.
- Large-woody-debris frequency and volume monitoring in South Fork Lost and Soup creeks.
- Stream temperature monitoring in South Fork Lost, Cilly, and Soup creeks.

Appendix F
Wildlife
Analysis

# APPENDIX F
# WILDLIFE ANALYSIS

## INTRODUCTION

The discussion in this section pertains to wildlife species and their habitat in the existing environment and changes to that environment due to each alternative. If habitat does not exist in the project area or would not be modified by any alternative, species that use that habitat were dismissed from further analysis. Where species use of the area is probable, an analysis was performed. To conduct this analysis, a cumulative-effects analysis area was defined in which to assess the effects to the species in question. The Three Creeks Project Area, South Fork Lost Soup Grizzly Bear Subunit, and Swan River State Forest scales were considered for possible analysis areas. The scale of analysis considered varied according to the species being discussed, but generally approximates the size of seasonal home ranges, total home ranges, or multiple home ranges representing a portion of the population for the species in question. Once an analysis area for cumulative effects was defined, the existing condition within the analysis boundaries was determined to set the baseline. The existing condition (baseline) incorporates the results of the past actions and natural processes within the analysis area.

To assess the effects of each alternative, the changes that would occur due to project activities are described within the area where they occur (i.e., within the harvest unit). These changes are the direct and indirect effects of the proposed activities. The cumulative effects analysis considers how these changes alter the existing condition (which includes past actions) and what that means to the species in question at the analysis-area scale. After these changes and the subsequent effects are displayed and discussed, other activities that are occurring or are planned in the foreseeable future within the cumulative-effects analysis area are added into the effects analysis. The combination of the effects of the current proposal overlaid on the existing condition, with the addition of concurrent and foreseeable future actions, sum to determine the cumulative effect to the species in question.

## METHODS

To assess the existing condition on DNRC-managed lands and the surrounding landscape within each cumulative-effects analysis area, a variety of techniques were used. Field reconnaissance , scientific literature, data from the SLI and MNHP, aerial photography, consultations with other professionals, and professional judgment provided information for the following discussion and effects analysis. In the effects analysis, changes in the habitat quality and quantity from the existing conditions were evaluated and explained.

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Specialized methodologies are discussed under the species in which they apply.

## COARSE-FILTER ANALYSIS

DNRC recognizes that it is an impossible and unnecessary task to assess an affected environment or the effects of proposed actions on all wildlife species. We assume that if landscape patterns and processes similar to those that species adapted to are maintained, then the full complement of species will be maintained across the landscape (*DNRC 1996*). This "coarse filter" approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate "historic conditions" across a landscape. In the coarse-filter analysis, disturbance, covertype and age class, forest connectivity, and snags and coarse woody debris were analyzed.

### *DISTURBANCE*

#### Issue

Timber harvesting and the associated road use would increase motorized disturbance in the analysis area, which could result in displacement of wildlife species from adjacent habitats. Displacement from important habitats could result in decreased ability for the animal to survive and reproduce in the analysis area.

#### Existing Condition

Motorized disturbances can affect how wildlife species use their environment. Some species, such as grizzly bears and elk, are particularly sensitive to the disturbance related to motorized access and tend to avoid areas some distance from the source of disturbance. Conversely, some species, such as Canada lynx, tolerate motorized disturbance and do not alter their use of adjacent habitats substantially (*Mowat et al. 2000*). Additionally, the response to motorized disturbance and the distance of displacement effects can vary among individuals within a species. Therefore, this analysis focuses on quantifying the area where disturbance occurs (roads and harvest units) to rank the potential displacement effects caused by disturbance expected under all action alternatives.

The area where disturbance from motorized use occurs is the road surface; however, the displacement effects caused by the disturbance can extend well away from the road surface. Motorized disturbances related to this project would occur on the road surface by vehicles traveling to and from harvest units and by mechanized equipment and personnel within the harvest units. To quantify the minimum amount of disturbance, the acreage of driving surface of forest roads (14 feet wide) and Highway 83 (40 feet wide) were used to develop a hierarchy of potential disturbance to wildlife in the area. The effects of this disturbance resulting in displacement would extend some distance from the point of disturbance, which would vary by the species in question.

The South Fork Lost Soup Subunit cumulative-effects analysis area consists of the project area and valley bottom. The project area lies on the slopes above the valley bottom and extends upslope toward the Swan divide. The project area contains 8.4 miles of open road covering 14.5 acres (0.1 percent of the project area) and 20.1 miles of restricted roads (gated) covering 34.7 acres (0.3 percent) (*TABLE F-1 - ACREAGE OF ROAD SURFACES [PERCENT OF AREA] AT THE PROJECT LEVEL AND IN THE ANALYSIS AREA*). Due to the lack of open roads in the area, the project area experiences limited motorized access. The restricted roads in the area support minor levels of motorized administrative use. In the valley bottom, Highway 83 runs north and south near the

western edge of the subunit, with 2 main open roads (Cilly Creek and Soup Creek roads) running east towards the mountains. Other open roads enter the project area from the north (South Fork Lost Creek Road) and the south (Soup Goat Cut-Across Road). These roads stay near the valley bottom or, in the case of South Fork Lost Road, follow the creek up the drainage bottom. All other roads are restricted, but provide for motorized administrative and public nonmotorized access. Highway 83 accounts for 4.8 miles, covering 23.3 acres (0.1 percent of the analysis area); open roads account for 22.2 miles, covering 37.7 acres (0.1 percent); and restricted roads (gated) account for 47.8 miles, covering 81.1 acres (0.3 percent) of the 74.8 miles of roads in the analysis area (*TABLE F-1 - ACREAGE OF ROAD SURFACES [PERCENT OF AREA] AT THE PROJECT LEVEL AND IN THE ANALYSIS AREA*).

Consistent high levels of motorized use occur on Highway 83. There appears to be a relatively consistent moderate level of motorized use along open roads, with spikes during different seasons (i.e. big game hunting season). The motorized use occurring consistently on these open roads is generally associated with recreational traffic (traffic associated with sightseeing or accessing a recreational area), public firewood harvesting, and administrative use. Motorized vehicles on restricted roads are limited to administrative use while the subunit is inactive and commercial use when the subunit is active.

**Predicted Effects to Wildlife Species Due to Disturbance**

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Disturbance***

  No additional disturbances along existing roads or within harvest units would occur; therefore, no additional displacement of wildlife species would be expected.

- ***Direct and Indirect Effects of the Disturbance Resulting from Action Alternatives B, C, D, and E***

  The amount of area that receives motorized disturbance would increase under all alternatives. These increases would result from the use of existing and newly constructed roads along with motorized activities in the harvest units. The increased vehicle traffic associated with each alternative on the highway and open roads would likely contribute negligibly to the displacement effects already occurring. However, introducing motorized disturbance within the harvest units and newly constructed road, along with increasing motorized use on existing restricted roads, would likely add to the amount of area where displacement could occur.

  To quantify the scale of disturbance associated with each alternative, the acreage of harvest units and driving surface of restricted roads (14 feet wide) were summed to develop a hierarchy of potential disturbance to wildlife in the area. All action alternatives would be implemented during a 3-year period. If the project is not completed during this time period, harvesting activities could

***TABLE F-1 - ACREAGE OF ROAD SURFACES (PERCENT OF AREA) AT THE PROJECT LEVEL AND IN THE ANALYSIS AREA***

| ROAD STATUS | PROJECT LEVEL | ANALYSIS AREA |
|---|---|---|
| Highway | 0.0 (<0.1%) | 23.3 (0.1%) |
| Open | 14.5 (0.5%) | 37.7 (0.1%) |
| Restricted - gated | 34.7 (0.3%) | 81.1 (0.3%) |
| Total roads | 49.2 (0.5%) | 142.1 (0.5%) |

potentially extend past 2009; but, if activities were extended, they would only occur between November 16 and March 31. At any time, any or all portions of the timber harvesting and road use could occur. This analysis considers each alternative as a whole and does not try to predict the timing of any phase of implementation of the alternative. Since this project is likely to be split into 3 timber sales, the effects expected under any alternative would likely be spread over time and space in some fashion. According to this analysis, Action Alternative E would produce the greatest amount of area where short-term disturbance would occur, followed by Action Alternatives D, B, and C, respectively (*TABLE F-2 - ACREAGE OF DISTURBED AREA WITHIN HARVEST UNITS AND ASSOCIATED ROAD USE EXPECTED UNDER EACH ALTERNATIVE*). The displacement effects due to motorized disturbance may extend for some distance away from the source and may vary by species and individual animals. Therefore, the risk of increased motorized disturbances resulting in displacement of wildlife species from important habitats follows the same trend. These effects are expected to last for the duration of the project. After completion of the project, some displaced species could move back into the area. The speed at which recolonization occurs would vary by species.

***TABLE F-2 - ACREAGE OF DISTURBED AREA WITHIN HARVEST UNITS AND ASSOCIATED ROAD USE EXPECTED UNDER EACH ALTERNATIVE***

| DISTURBANCE AREA | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Harvest acres | 0 | 1,883 | 1,795 | 1,970 | 1,998 |
| (Percent of project area) | | (17.7) | (16.9) | (18.5) | (18.8) |
| (Percent of analysis area) | | (6.3) | (6.0) | (6.6) | (6.7) |
| Existing restricted road driving surface acres | 0 | 39 | 36 | 35 | 45 |
| (Percent of project area) | | (0.4) | (0.3) | (0.3) | (0.4) |
| (Percent of analysis area) | | (0.1) | (0.1) | (0.1) | (0.2) |
| New road construction of permanent restricted driving surface acres | 0 | 23 | 22 | 27 | 15 |
| (Percent of project area) | | (0.2) | (0.2) | (0.3) | (0.1) |
| (Percent of analysis area) | | (0.1) | (0.1) | (0.1) | (0.1) |
| New road construction of temporary driving surface acres | 0 | 9 | 11 | 7 | 8 |
| (Percent of project area) | | (0.1) | (0.1) | (0.1) | (0.1) |
| (Percent of analysis area) | | (0.0) | (<0.1) | (<0.1) | (<0.1) |
| Total combined acres affected | 0 | 1,954 | 1,864 | 2,039 | 2,066 |
| (Percent of project area) | | (18.4) | (17.5) | (19.2) | (19.4) |
| (Percent of analysis area) | | (6.5) | (6.2) | (6.8) | (6.9) |

- ***Cumulative Effects of No-Action Alternative A to Disturbance***

Wildlife species are not expected to change their use of the analysis areas.

- ***Cumulative Effects to Disturbance Common to Action Alternatives B, C, D, and E***

In the longer term, the new construction of permanent restricted roads under each action alternative would increase the ability for administrative motorized and public nonmotorized access. Of these alternatives, Action Alternative D would result in the greatest potential for additional disturbance over the long term due to the greatest increase in permanent road construction. Action Alternative E would require the least amount of permanent restricted road and thereby would result in the least risk of disturbance over the long term. Since administrative use is generally light and sporadic, the risk of additional or continued displacement is low. Since nonmotorized use generally results in fewer disturbances than motorized use and any increase in nonmotorized use is expected to be sporadic and not result in large changes over the existing condition, any additional risk to displacement due to the construction of new restricted roads is likely to be low under any action alternative.

In addition to the potential disturbance caused by each action alternative, DNRC is concurrently considering 2 salvage harvests that total 120 acres and uses 5 acres of existing restricted road surface in 2 locations within the analysis area. These harvests could add approximately 125 acres (0.4 percent of the analysis area) to the amount of habitat affected if these projects ran concurrently with the Three Creeks Timber Sale Project. The duration for the use of these roads and harvesting is expected to be less than 30 days. Therefore, the cumulative effects to any alternative would likely result in short-term negligible increases in displacement (*TABLE F-3 - CUMULATIVE AMOUNT OF ACRES WITHIN THE ANALYSIS AREA EXPECTED*

***TABLE F-3 - CUMULATIVE AMOUNT OF ACRES WITHIN THE ANALYSIS AREA EXPECTED TO BE DISTURBED UNDER EACH ALTERNATIVE***

| DISTURBANCE AREA | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Existing acres of all roads | 142 | 142 | 142 | 142 | 142 |
| (Percent of analysis area) | (0.5) | (0.5) | (0.5) | (0.5) | (0.5) |
| Total affected acreage by alternative in the analysis area | 142 | 2,096 | 2,006 | 2,181 | 2,208 |
| (Percent of analysis area) | (0.5) | (7.0) | (6.7) | (7.3) | (7.4) |
| Additional projects (acres) | 125 | 125 | 125 | 125 | 125 |
| (Percent of analysis area) | (0.4) | (0.4) | (0.4) | (0.4) | (0.4) |
| Total cumulatively affected acreage in the analysis area | 267 | 2,221 | 2,131 | 2,306 | 2,333 |
| (Percent of analysis area) | (0.9) | (7.4) | (7.1) | (7.7) | (7.8) |

*TO BE DISTURBED UNDER EACH ALTERNATIVE*).

### *COVERTYPES AND AGE CLASSES*

#### Issue

Timber harvesting and natural processes can alter the distribution of covertypes and age classes found on the landscape. Changes from historic conditions could result in adverse effects to native wildlife species.

#### Existing Condition

Covertype and age class proportions provide a variety of habitats for wildlife species. It is assumed that the closer the proportions and distributions of covertypes and age classes mirror the "historic levels" reported by *Losensky (1997)*, the more likely DNRC-managed lands are providing adequate levels of habitat for native species (see *APPENDIX C - VEGETATION ANALYSIS*). Based on the vegetation analysis conducted on the SLI data, mixed-conifer covertypes are overrepresented, while western larch/Douglas-fir and western white pine are underrepresented when compared to historic levels. When averaged over all covertypes, stands on Swan River State Forest tend to be older than expected. These conditions likely lead to increased habitat for species that use older, denser stands, which include a variety of tree species at the expense of species that use more-open stands dominated by shade-intolerant tree species.

#### Predicted Effects to Wildlife Species Due to Changes in Covertypes and Age Classes

- ***Direct and Indirect Effects of the No-Action Alternative A to Covertypes and Age Classes***

  No changes in covertypes or age classes are expected in the short term. Over time, trees would continue to age and shade-intolerant trees would continue to die and be replaced by shade-tolerant species. These conditions would lead to an increasing deviation from historic distributions of covertypes and age classes. These changes would continue and increase the risk of not providing adequate levels of habitat for native species.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E to Covertypes and Age Classes***

  Under all action alternatives, a portion of the harvested stands would be converted from mixed-conifer covertypes to shade-intolerant covertypes (western larch/Douglas-fir and western white pine) and also reduce the average age of stands. These changes in covertypes and the conversion of older stands to younger stands move the stand proportions toward historic conditions; however, historic age distributions may not necessarily be retained within those covertypes. Specifically, the conversion of older western larch/ Douglas-fir and ponderosa pine stands into younger stand classes causes movement away from historic age class proportions in these covertypes (see *APPENDIX C - VEGETATION ANALYSIS*). Reductions of older-aged stands in other covertypes move Swan River State Forest more toward historic conditions of age class within the covertypes affected. The changes proposed are expected to result in beneficial effects for species that use shade-intolerant covertypes; however, these benefits may be delayed due to the conversion of older-aged stands to younger-aged shade-intolerant stands. In the short-term, species that use older, denser stands with a variety of tree species would be negatively impacted; however, these species would likely still have at least as much, if not more, habitat available than would be expected under historic conditions. Action Alternative C would result in a higher rate of conversion from

mixed-conifer to western larch/ Douglas-fir covertypes, while retaining a higher proportion of older-aged stands, followed by Action Alternatives D, B, and E, respectively. Action Alternatives C, D, and E would enter approximately 18 acres of ponderosa pine old stands and reduce the age class to a 100-year-old stand.

- ***Cumulative Effects of No All Alternatives Covertypes and Age Classes***

  The cumulative effects of recent forest-management activities on Swan River State Forest result in a trend of increasing seral covertypes and the amount of younger age classes across areas where management has occurred. These trends generally tend toward historic proportions; therefore, native species are generally benefiting from the changes in covertype and age-class distributions. However, these benefits may be delayed due to the conversion of older-aged stands to younger-aged shade-intolerant stands.

***OLD-GROWTH-ASSOCIATED SPECIES***

**Issue**

Old growth provides habitat components for a host of wildlife species. Decreasing amounts of habitat available to less than the amounts expected historically could adversely affect species that use old-growth habitats to fulfill their life requirements.

**Existing Condition**

Many wildlife species use old-growth habitats. *Warren (1998)* indicates that approximately 31 wildlife species are associated with old-growth forests on the FNF. *APPENDIX C - VEGETATION ANALYSIS* indicates that the current acreage of old growth on Swan River State Forest is less than the acres estimated in 1930s inventory, but greater than would be expected as a long-term average for the climatic section (*Losensky 1997*). Although the percentage of the area occupied by old growth, overall, on Swan River State Forest is presently greater than what would have been expected with long-term average conditions, function may be compromised for some species due to reductions of old growth in some covertypes and overall reductions in average patch size, patch shape, and loss of connectivity. The current distribution, covertypes, and attribute levels are displayed in *APPENDIX C - VEGETATION ANALYSIS*.

Based on the vegetation analysis of Swan River State Forest, overabundances of old growth occur in the Douglas-fir, western white pine, mixed-conifer (includes stands dominated by western red cedar), and subalpine fir covertypes, while shortages occur in ponderosa pine, western larch/Douglas-fir, and lodgepole pine covertypes. These differences are attributable to the differential selection of covertypes that were harvested, covertype conversions due to fire exclusion and forest succession, and a minor degree of classification and sampling error. Wildlife species typically associated with old growth in the covertypes that are overrepresented presumably benefited from additional habitat, while those associated with underrepresented types likely suffered from lower amounts of available habitat.

**Predicted Effects to Old-Growth-Associated Species**

***Direct and Indirect Effects***

- ***Direct and Indirect Effects of the No-Action Alternative A to Old-Growth-Associated Species***

  No harvesting of timber would take place; therefore, no changes in the amount or quality of old-

growth habitats would occur.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E to Old-Growth-Associated Species***

  Some amount of stand-replacement-type harvesting of old growth would occur under each action alternative. Thus, young age classes of stands would likely develop for several years following treatments. In some harvest units, the number of large trees retained could meet the minimum criteria for old-growth; however, these stands may not necessarily meet the needs of old-growth-associated species, especially those species that prefer densely forested climax stands. Where old-growth habitat is altered, old-growth-associated species are expected to lose habitat.

***Cumulative Effects***

- ***Cumulative Effects of All Alternatives to Old-Growth–Associated Species***

  Following harvesting, all action alternatives retain proportions of old growth within Swan River State Forest that fall within the estimated range of historical amounts of old growth (15 to 52 percent). Therefore, the overall risk of adverse effects to species that use these habitats is low because levels of old-growth habitats fall within the historic range expected on Swan River State Forest (see *APPENDIX C - VEGETATION ANALYSIS*). However, local reductions in old-growth habitats are expected to reduce habitat availability for species that use these habitats. The risk of affecting old-growth-associated species is greater under Action Alternative D than under Action Alternatives C, B, and E, respectively, due to the amount of old-growth harvested.

  No other harvests in old-growth stands are concurrently being considered or planned in the foreseeable future. Past activities that affected old growth were considered in the existing conditions. Therefore, no additional cumulative changes in the amount of old-growth stands are expected.

*FORESTED CONNECTIVITY*

**Issue**

Timber harvesting would remove forested cover that could result in the reduced ability of some wildlife species to move through their home range. Disruption of these regular daily, seasonal, and dispersal movements could result in a reduced ability of wildlife species to use and successfully reproduce in the area.

**Existing Condition**

Movement corridors that maintain connectivity between habitat patches function to allow regular daily and seasonal movements along with providing dispersal routes for juvenile animals (*Dobson et al. 1999*). These movements are important for species to successfully move between security cover (i.e. denning sites, bedding areas, etc.) and foraging sites to meet their life requirements. Additionally, movement corridors are important to allow for dispersing individuals to immigrate or emigrate from one population to the next to allow for genetic diversity.

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross broad, nonforested expanses. In general, wider, unfragmented, riparian, and diverse corridors provide the most effective connectivity (*Fischer and Fischenich 2000*). The width of the travel corridor tends to determine the efficacy of the corridor for individual species. In general, a wider corridor would be more effective and provide for more species than a narrower one. Narrower corridors provide some

level of connectivity, especially for smaller species, such as rodents. However, these narrow corridors could also serve as funnels that increase predator efficiency and reduce survival of the individual prey species that are using the corridor (*Groom et al. 1999*). Seedling and sapling stands can also provide connectivity cover for some species such as snowshoe hares (*Ausband 2004*), but may not provide connectivity for species that prefer environments with dense mature forest canopy.

Based on *ARM 36.11.403(20)(b)*, corridors of 300 feet or greater are assumed to allow adequate connectivity to the larger mammals that inhabit the project area, such as fishers (*Jones 1991*) and lynx (*Koehler 1990*). To assess connectivity, semi-closed (40- to 70-percent canopy closure) and closed canopy (greater than 70-percent canopy closure) pole and sawtimber stands greater than 300 feet wide were considered to provide travel cover for species expected to benefit from interconnected forest stands.

The South Fork Lost Soup Subunit cumulative-effects analysis area consists of valley bottom and mountainous terrain. The project area lies on the slopes between the valley bottom and the upper elevations of the subunit. Generally, high levels of forest connectivity exist in the mountainous area, with many scattered openings existing on the valley floor portions of the analysis area. Forest connectivity is mostly maintained throughout the analysis area along the ridges, along 4 major streams running from the mountains and draining into the Swan River, and across third-order drainages (South Fork Lost and Soup creeks). Several breaks where forest cover is reduced to less than 300 feet across the stream occur along these creeks (*FIGURE F-1 - EXISTING FOREST COVER, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*). These openings are natural openings (wet meadows, shrub fields, avalanche chutes) or old harvest units. In most cases, these openings contain at least some horizontal cover from shrubs or regenerating trees, thereby providing some cover within the opening. Additionally, these areas are generally small (*FIGURE F-1 - EXISTING FOREST COVER, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*). These conditions provide a well-connected forest environment for animals to move relatively unimpeded through the cumulative-effects analysis area. However, in the valley bottom, several open roads, including Highway 83, present human-caused impediments to connectivity.

**Predicted Effects to Wildlife Due to Changes in Connectivity**

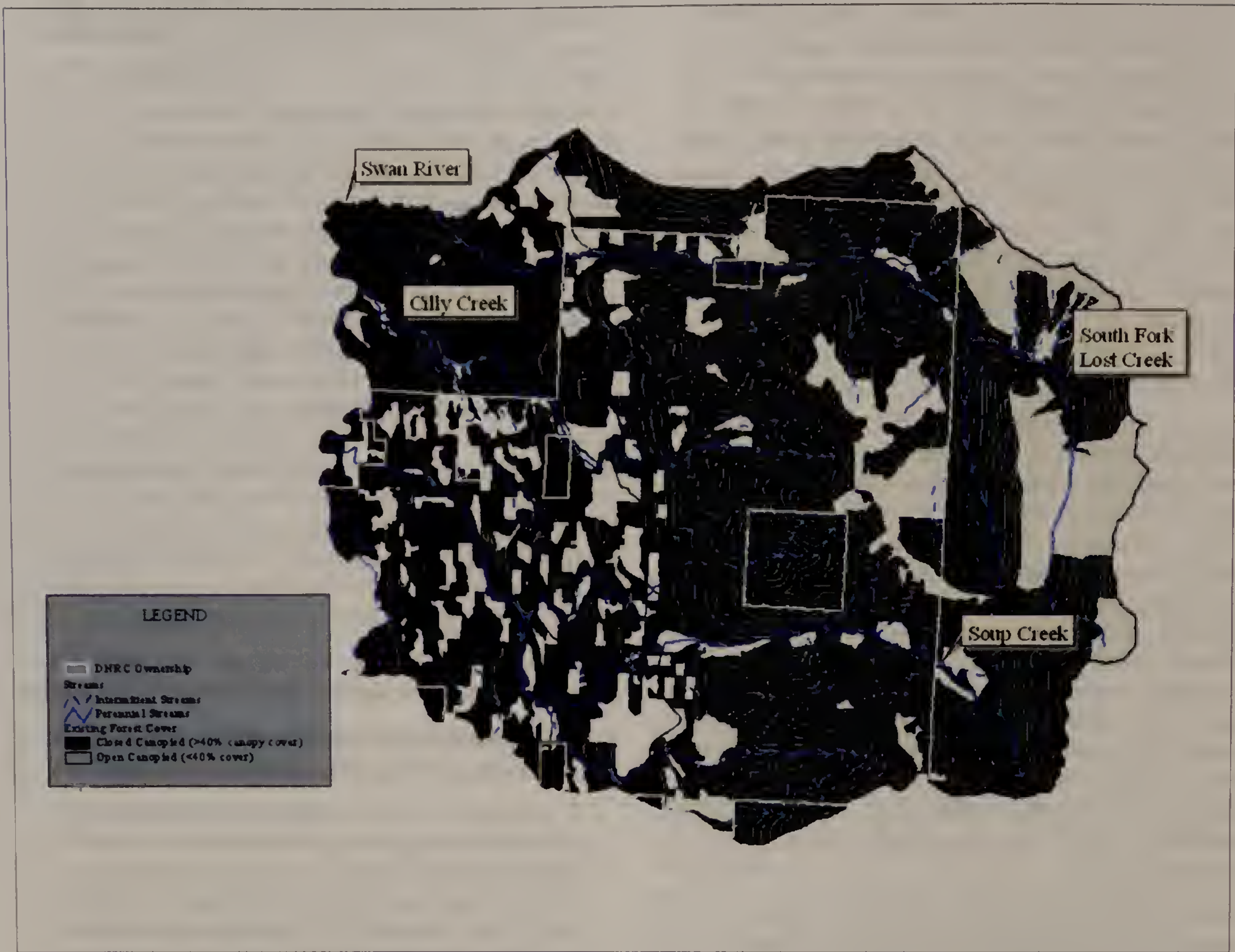
- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Connectivity***

  No short-term changes in forest connectivity are expected. Over time and in the absence of natural disturbance, forest connectivity would be expected to increase due to the successional conversion of early seral stands and sparse stands to older stands providing overhead forest cover. The increase in connectivity would benefit species that depend on dense interconnected forests by providing movement corridors between habitats within the project area.

- ***Direct and Indirect Effects Common of Action Alternatives B, C, D, and E to Connectivity***

  Each action alterative could alter connectivity of mature forest patches by creating gaps and producing large openings in the uplands (refer to *PATCH SIZE in this analysis*). However, the project design for each alternative includes mitigations to maintain forest connectivity

*FIGURE F-1 - EXISTING FOREST COVER, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*




along the 4 major streams (Soup, Cilly, Unnamed, and South Fork Lost creeks) in the project area. Where seedtree or shelterwood prescriptions occur on both sides of a major stream, a 150-foot buffer on either side of the stream (300-foot width total) would be retained. If harvesting occurs on only 1 side of the stream and ample forest cover is provided on the opposite side of the stream, a 100-foot buffer from the stream would be retained along the harvested portion. Along the 4 main streams, no timber-harvesting activities would occur within 25 feet of the stream. From 25 feet to the buffer width, up to half of the trees 8 inches dbh or greater could be harvested, but an average of 40 percent or greater canopy cover would be required to be retained. In these buffers, small openings of 0.25 acre or less could occur in cable yarding corridors or in skid trails.

Forest connectivity through the project area would be retained in unharvested stands along the ridges (south of South Fork Lost, Cilly, and Soup creeks), across third-order drainages (Soup and South Fork Lost creeks), and along streams with the buffers described above (*FIGURE F-2 (3, 4, 5) - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE B (C, D, and E), WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*). With these mitigations in

*FIGURE F-2 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE B, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*

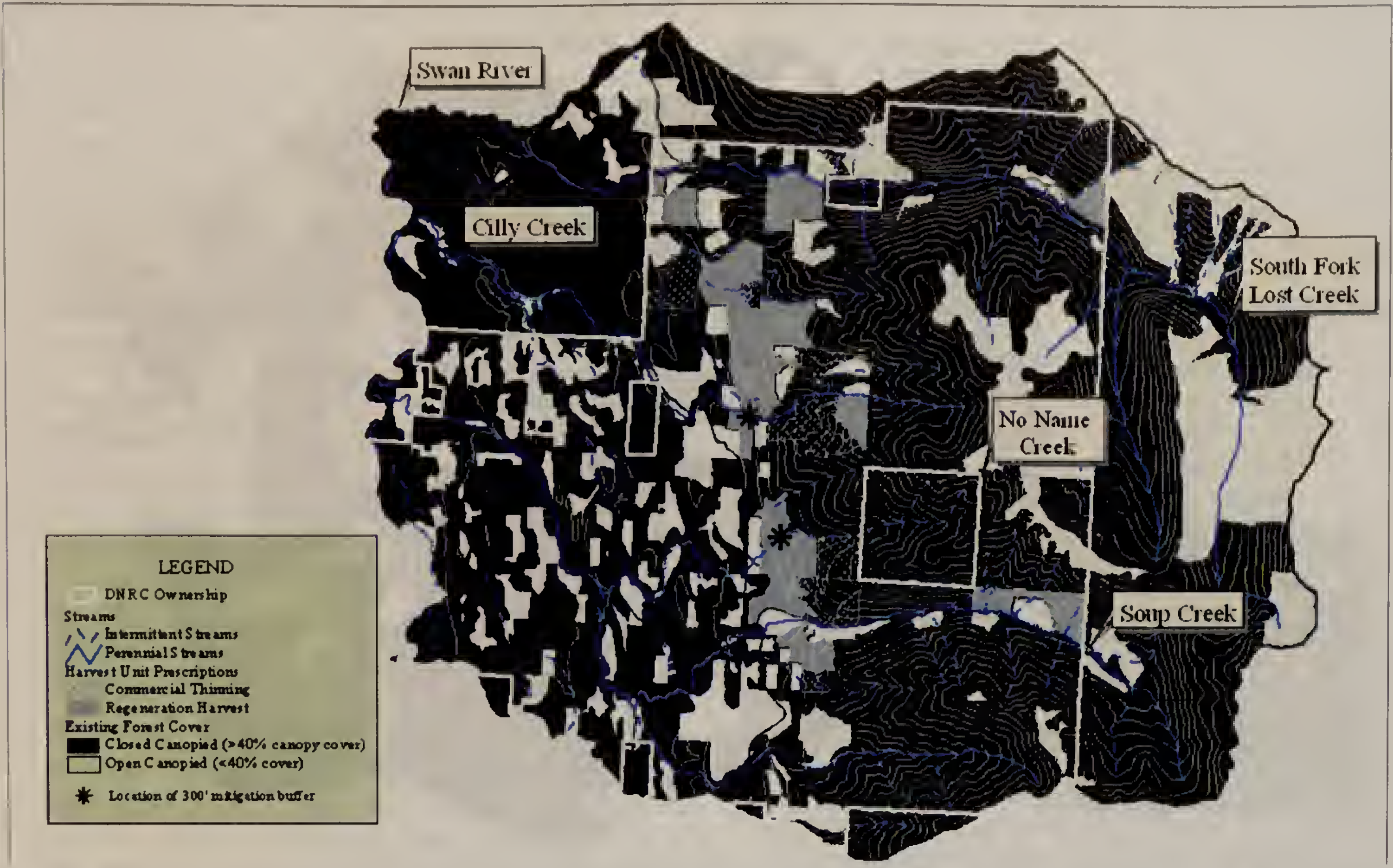
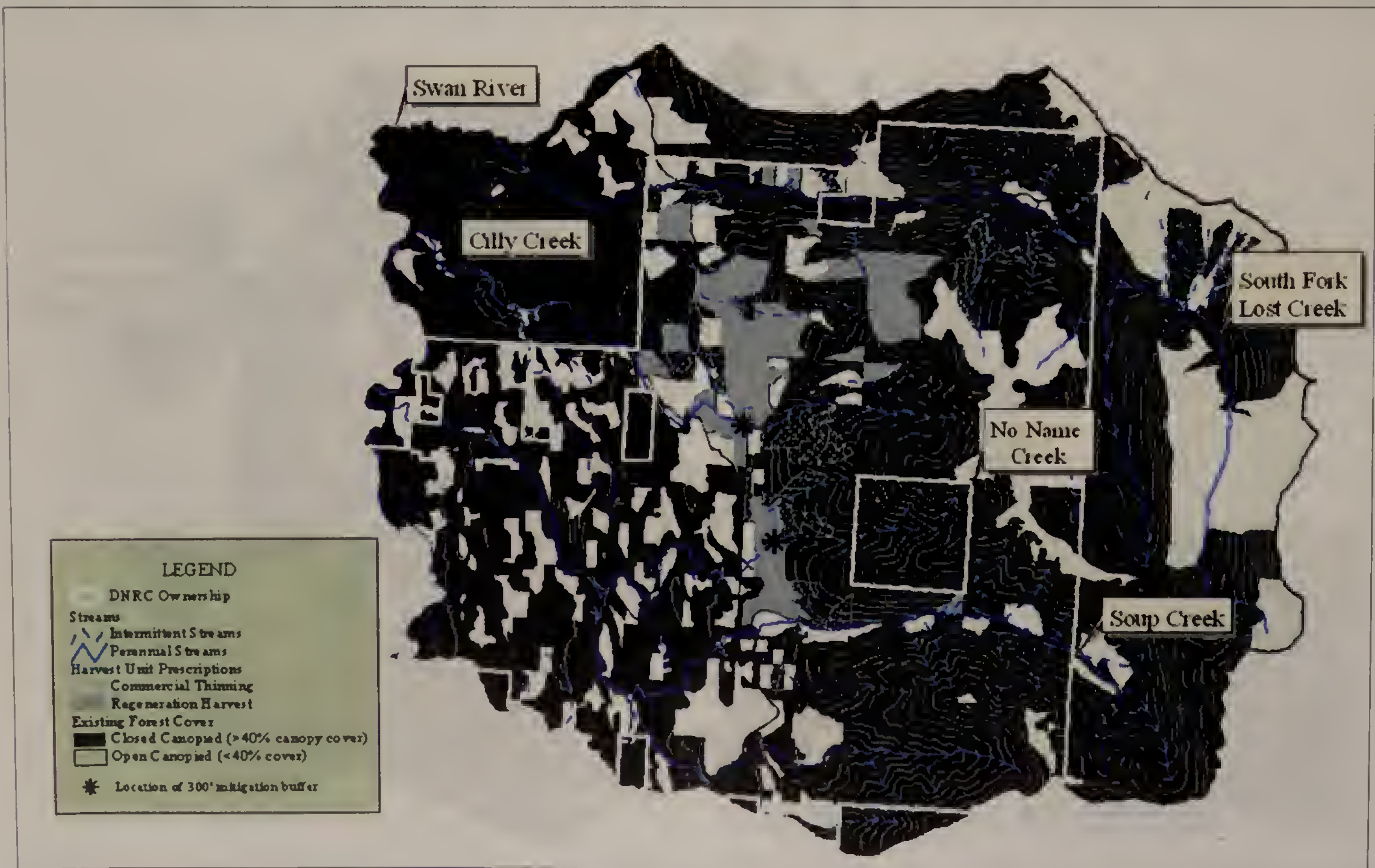



*FIGURE F-3 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE C, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*

FIGURE F-4 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE D, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA


FIGURE F-5 - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE E, WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS



place, a minimum of 300-foot wide corridors would be retained along all major creeks that run through the harvest units. Connectivity on upland sites would be reduced under each alternative, but in areas used by wildlife species for travel (ridges and streams), adequate forest cover would remain. Therefore, all alternatives would result in minor risk to preventing movement through the project area.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E***

Other activities that could affect forested connectivity in the analysis area include: open roads, DNRC salvage harvests, potential timber harvests on adjacent lands, and tree mortality due to insects and diseases.

The highway (4.8 miles) and open roads (22.2 miles) currently in the analysis area would continue to decrease habitat connectivity to some unknown level. All action alternatives under this project result in an additional 0.4 miles of open road. The new road would result from rerouting South Fork Lost Creek Road away from the creek. Although a slight increase in the length of open roads would occur from moving the road out of the South Fork Lost Creek riparian area, connectivity could improve by reducing the disturbance in the riparian corridor. This action would enhance forested connectivity along the 1.3 miles of stream where disturbance would be reduced.

In addition to this project, DNRC is proposing to harvest 120 acres in 2 projects, while no other harvests on other ownerships are planned for the 3-year active period. The DNRC salvage harvests would occur on the valley floor, but away from streams. Additionally, the harvests would not likely reduce the canopy closure to less than 40 percent. Therefore, wildlife species could still move through the area, resulting in negligible additional reductions in connectivity.

Insect and disease activity continues to kill trees in the analysis area. These agents tend to kill the larger trees, leaving the smaller trees in the understory. As the larger overstory trees die, the younger trees grow and fill in the gap left by the dead overstory trees. In most cases, this situation results in retaining forested cover. In some cases, patches of trees are killed, leaving open forested cover. If these patches attain a large size, forest connectivity could be reduced. In the analysis area, the effects of insects and diseases tend to shift the proportions of tree species in stands, but retain 40-percent canopy closure, or at least horizontal cover in the stand. Therefore, only small, short-term additional reductions to forest connectivity due to insects and diseases are expected.

Considered in conjunction with other past, present, and future activities, any action alternatives would likely result in minor cumulative effects to connectivity.

### *PATCH SIZE*

#### Issue

Timber harvesting could reduce the average patch size of age classes. These changes could reduce habitat available for species that require a large patch size or interior habitats.

#### Existing Condition

Species that are hesitant to cross broad expanses without forest cover, or those that depend upon interior forest conditions, can be sensitive to the amount and spatial configuration of appropriate habitat. Therefore, patch size,

patch juxtaposition, and connectivity of forest patches can influence habitat quality and population dynamics for some species. Some species are adapted to thrive near patch edges, while others are adversely affected by the presence of edge, or by the presence of other animals that prosper in edge habitats. Therefore, this analysis considers the effects of patch size of age classes of forest stands (discussed in *APPENDIX C - VEGETATION ANALYSIS*) on wildlife species.

The current patch size in the project area and within Swan River State Forest deviates from historic conditions (refer to *APPENDIX C - VEGETATION ANALYSIS*). Presently, the average patch size is smaller than would be expected under historic conditions. Some of the decrease can be attributed to different map-unit minimums, but the data likely reflects a real reduction in mean patch sizes, as harvesting and roads have broken up some previously intact patches. These conditions probably lead to an increase in habitat for species that use a diversity of age classes or edge habitats at the expense of habitat for species that use interior habitats.

**Predicted Effects to Patch Size**

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Wildlife Species Due to Changes in Patch Size***

  Patch size and configuration would not change in the short-term within the project area or cumulative-effects analysis area (Swan River State Forest). In the longer term, without substantial natural disturbance, patch size is expected to increase in the older age-class categories, while diversity of habitats and edge habitats would decrease. Since the current mean patch size is smaller than expected under historic conditions, this alternative would allow movement toward historic conditions. Species that use large blocks of closed-canopy forested habitats would be impacted the least by this alternative.

- ***Direct and Indirect Effects of Action Alternatives B, C, D, and E to Wildlife Species Due to Changes in Patch Size***

  All action alternatives would reduce patch size of old-aged stands and increase patch size of the 0-to-39-year-old stands within the project area. All action alternatives reduce the average patch size of old stands by 50 to 55 percent. Action Alternatives B, E, C, and D, respectively, would result in the highest to lowest conversion of old stands to young stands. Conversely, all of the action alternatives propose harvests units to combine with current younger stands, resulting in increasing patch sizes of the 0-to-39-year-old age class. The results of all alternatives reduce the average patch size of old-aged stands further away from historic conditions, while increasing patch size in the 0-to-39-year-old age class over the historic average. Therefore, all alternatives trend away from historic patch size of old stands, resulting in a moderate risk of adverse impacts to species that use large patches of old-aged stands, while reducing the risk of adverse effects to species that use large patch sizes in the 0-to-39-year-old age class.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Wildlife Species Due to Changes in Patch Size***

  The effects discussed above are expected to also occur at the Swan River State Forest analysis scale. The current salvage operations would not alter the age class or patch size within the cumulative-effects analysis area. Ongoing and completed projects (360 acres) would add to the conversion of older stands to younger stands, resulting in a smaller mean patch

size of older stands and a larger mean patch size in the younger age class. Over time, these larger patches of younger stands would undergo successional processes to add to the patch size of the older age classes.

*COARSE WOODY DEBRIS*

**Issue**

Coarse woody debris provides important habitat attributes for a variety of wildlife species. Timber harvests could reduce coarse woody debris, leading to a decline in wildlife habitat quality. These declines could result in decreased survival or reproduction of species that require these attributes to fulfill their life or reproduction requirements.

**Existing Condition**

The presence of wildlife species contributes to healthy, functioning forests. Coarse woody debris provides structural diversity and promotes biological diversity by providing habitat for wildlife species. Many small mammals require coarse woody debris to survive. In turn, these species distribute ectomycorrhizal fungi, which is beneficial for seedling establishment and tree growth (*Amaranthus 1998, Graham et al. 1994*). The quality and distribution of coarse woody debris can affect habitat quality for these species. Higher quality habitat tends to be provided when coarse woody debris exists in longer lengths of large diameter logs than smaller and/or shorter logs. Single scattered logs provide lookout and travel sites for squirrels or access under the snow for small mammals and pine martens, while log piles provide habitat for weasels, hares, and other small mammals. Under natural conditions, logs tend to occur in patches across the landscape, with the occasional lone log.

Presently, the project area (cumulative effects analysis area) contains many stands with moderate to high levels of coarse woody debris (see *APPENDIX C - VEGETATION ANALYSIS*). Within the analysis area, past harvests have been limited, thereby allowing increases in coarse woody debris. With the high incidence of insect and disease activities (see *APPENDIX C - VEGETATION ANALYSIS*), these levels could continue to increase. High amounts of coarse woody debris provide habitat for a variety of wildlife species, which have likely gained habitat structure over time as stands age.

**Predicted Effects to Wildlife Species Due to Changes in Coarse Woody Debris**

- ***Direct, Indirect, and Cumulative Effects of the No-Action Alternative A to Coarse Woody Debris***

  No changes in amount, type, or distribution of coarse woody debris are expected. Overtime, coarse woody debris would increase in most stands due to trees dying and eventually falling to the ground. Under this alternative, species that use coarse woody debris would gain additional habitat, which would represent a low to moderate benefit to these species.

- ***Direct and Indirect Effect of Action Alternatives B, C, D, and E to Coarse Woody Debris***

  Coarse woody debris would be retained at 15 to 20 tons per acre within the harvest units (see *APPENDIX C - VEGETATION ANALYSIS*). In some cases, coarse woody debris could increase through harvesting; however, most of this material would be made up from pieces of cull boles, limbs, and tops. Few intact trees would be retained. Where broadcast burns are used for site preparation following harvesting, coarse woody debris could be further reduced. These reductions would occur mostly in the smaller-sized logs. The

coarse woody debris following harvesting would provide some wildlife habitat; however, species that use large pieces of coarse woody debris could likely lose a portion of their habitat components within the harvest units.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Coarse Woody Debris***

  No additional effects to those listed above are expected, because no other activities are planned within the cumulative-effects analysis area. The current levels of coarse woody debris in adjacent stands could mostly offset the changes expected within the harvests units. Additionally, the trees and snags retained in both harvested and unharvested stands would continue to provide a source of coarse-woody-debris recruitment over time. When past, present, and future actions were considered, a low risk that was projected by the changes in coarse woody debris under each alternative could result in substantial decreases in survival or reproduction of species that require these attributes to fulfill their life requirements. However, the risk level is higher in Action Alternative E, than in Action Alternatives D, B, and C, respectively.

***SNAG STRUCTURE***

**Issue**

Snags provide important habitat attributes for a variety of wildlife species. Timber harvests could reduce the density of snags, leading to a decline in the quality of wildlife habitat. These declines could result in decreased survival or reproduction of species that require these attributes to fulfill their life or reproduction requirements.

**Existing Condition**

Snags play an important role in forested ecosystems by providing feeding and nesting sites for birds and mammals. Snags provide foraging sites for primary cavity-nesting species, along with structural components to excavate nesting sites. The cavities excavated by primary cavity-nesting species (woodpeckers) also provide habitat for secondary cavity users. These secondary cavity users include both birds and mammals. Additionally, these secondary cavity users could also take advantage of cavities produced by broken tops and fallen limbs. Without trees and snags that provide for cavities or substrate for cavity excavation, primary and secondary cavity species would not be able to survive and/or reproduce in the area.

The presence of some forest-dwelling birds is important to forest management. Several studies suggest that bird species diversity and population levels correlate with snag diversity and density (*McClelland 1979*). Birds provide many functions in forest ecosystems from dispersion of seeds to biological control of many forests insects that are harmful to wood production by predation, habitat modification (bark flaking), and providing avenues for disease transmission that reduces survival (*Ovtos 1979, Steeger et al. 1998*). Maintenance of insectivorous bird populations over time delays onset of insect outbreaks, accelerates the decline following an outbreak, and increases the time span between outbreaks (*Otvos 1979, Torgenson 1994*). In 27 studies reviewed by *Steeger et al (1998)*, 26 concluded that insectivorous birds substantially reduced bark beetle survival. Estimates from these studies indicated a reduction in insect populations from 2 to 98 percent. *Koplin (1972)* estimated that a single three-toed woodpecker could consume several thousand beetle larvae per day. In addition to predation, some studies indicate that woodpeckers can contribute to

bark beetle mortality indirectly by bark flaking, excavating, puncturing, etc., the bark of infected trees, thereby increasing parasite access to beetle brood (*Otvos 1965*) and altering the microclimate needed for survival (*Otvos 1979*). In areas with high densities of insects, woodpecker abundance can increase up to 7-fold during the breeding season and 85-fold during the winter. Downy, hairy, three-toed, and black-backed woodpeckers tend to be more apt than other species to congregate in these areas (*Steeger et al. 1998*). Some increased reproduction in response to insect outbreaks could occur, however, when a time lag between insect populations and the numerical response of their predators may take place. During time lags, the chance of insect epidemics may be greater. The ability of these species to congregate and reduce prey in such areas is dependent on maintenance of populations over time and retention of suitable habitat in the affected area (*Otvos 1979*).

The tree species, diameter, height, decay stage, and densities of snags determine the snag-habitat value for wildlife species. Larger, taller snags tend to provide nesting sites, while shorter snags and stumps tend to provide feeding sites for birds (*Bull et al. 1997*). Cavity-nesting birds often nest in areas where several snags are available, using individual snags as feeding or roosting sites; therefore, considering the size and distribution of these resources is important. Many birds that use smaller snags will also use large snags; however, the opposite is not true.

To assess effects to primary and secondary cavity-nesting species, the project area was used for the cumulative-effects analysis area. The project area incorporates 10,636 acres of DNRC-managed lands, which could provide numerous breeding ranges for cavity-nesting species.

The past management in this area is reflected by the existing condition. For the most part, the analysis area has been relatively unaffected by timber harvests in the recent past. Several open and restricted roads allow access into the analysis area. Public firewood cutting has taken place primarily in areas adjacent to these open roads, while DNRC-initiated salvage harvests used both open and restricted roads to access dead and dying trees. These harvests primarily removed Douglas-fir and grand fir snags, with some diseased western white pine and western larch snags also harvested. Due to the age of the stands and the presence of insects and diseases, snag development continues to occur.

To estimate an historic level of snag densities for the analysis area, the mean snag densities reported (snags/acre) from uncut stands in *Harris (1999)* were used. *Harris (1999)* looked at *Forest Inventory and Analysis* plot data from around western Montana in an attempt to estimate the abundance of snags in the absence of timber harvests. He calculated mean snag densities based on habitat type group (*Green et al. 1992, Pfister et al. 1977*). It is important to note that the averages based on habitat type group occurred throughout western Montana, not just within the analysis area or Swan valley. In this analysis, no attempt was made to modify the plot means to account for other sources of biases (fire suppression). Therefore, the historic estimates are likely overestimated (*Harris 1999*). However, these are the best data available to estimate historic snag abundance in the analysis area.

To calculate an estimated average historic snag density for the analysis area, the area was divided into habitat-type group using SLI data. For each habitat-type group, only those acres with stands older than 40 years were assumed to have snags for this analysis. For each

habitat-type group, all acres of stands greater than 40 years old were multiplied by the corresponding mean snag density for uncut stands reported in *Harris (1999)*. This calculation produced a weighted average to estimate the mean density of snags in the analysis area. The result of this analysis estimated that the cumulative-effects analysis area contains 0.89 large snags/acre and 2.73 medium snags/acre, on average (*TABLE F-4 - ESTIMATED HISTORICAL SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING HARRIS [1999]*).

To understand how the existing condition relates to the estimated historic condition, snag estimates in the SLI dataset were used. The acres of stands older than 40 years in the analysis area were summed by habitat-type group. Using SLI data for the analysis area, an average snag density was obtained for each habitat type group. Habitat-Type Group C did not have SLI snag data collected for stands within the analysis area; therefore, the average was obtained by using stands within Swan River State Forest that had snag data recorded (the methodology is included in the project file). The acres of stands over 40 years old were multiplied by the average SLI snag densities in the corresponding habitat-type group. This calculation resulted in a weighted average based on acres to estimate the current average snag density in the analysis area. Following this method, an average of 3.12 large snags per acre and 5.86 medium snags per acre occur in the analysis area (*TABLE F-5 - ESTIMATED EXISTING SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING SLI DATA*). This average density of large snags is 244 percent higher and the density of medium snags is 119 percent higher in the analysis area than the estimated historical level.

The higher density of snags in the analysis area over what would be expected historically is not surprising. The analysis area consists of predominantly older stands that have been, or are being, afflicted by insect and disease agents. In these stands, many of the older, larger trees have succumbed to old age or the effects

***TABLE F-4 - ESTIMATED HISTORICAL SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING HARRIS (1999)***

| HABITAT TYPE GROUP | ACRES IN ANALYSIS AREA (OVER 40 YEARS OLD) | AVERAGE DENSITY OF LARGE SNAGS ON UNCUT STANDS IN *HARRIS (1999)* (NUMBER OF PLOTS SAMPLED) | TOTAL ESTIMATED LARGE SNAGS IN THE ANALYSIS AREA | AVERAGE DENSITY OF MEDIUM SNAGS ON UNCUT STANDS IN HARRIS (1999) (NUMBER OF PLOTS SAMPLED) | TOTAL ESTIMATED MEDIUM SNAGS IN THE ANALYSIS AREA |
|---|---|---|---|---|---|
| B | 80 | 0.5 (181) | 40 | 1.4 (181) | 112 |
| C | 90 | 0.5 (122) | 45 | 1.4 (122) | 126 |
| D | 4,775 | 1.2 (102) | 5,730 | 3.9 (102) | 18,623 |
| E | 3,789 | 0.9 (284) | 3,410 | 2.4 (284) | 9,094 |
| G | 75 | 1.0 (33) | 75 | 1.4 (33) | 105 |
| H | 228 | 0.5 (33) | 114 | 2.4 (33) | 547 |
| I | 69 | 0.8 (202) | 55 | 4.6 (202) | 317 |
| J | 30 | 1.0 (41) | 30 | 2.3 (41) | 69 |
| Total | 10,636 | | 9,499 | | 28,993 |
| Average snags/ acre | | | 0.89 | | 2.73 |

*TABLE F-5 - ESTIMATED EXISTING SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING SLI DATA*

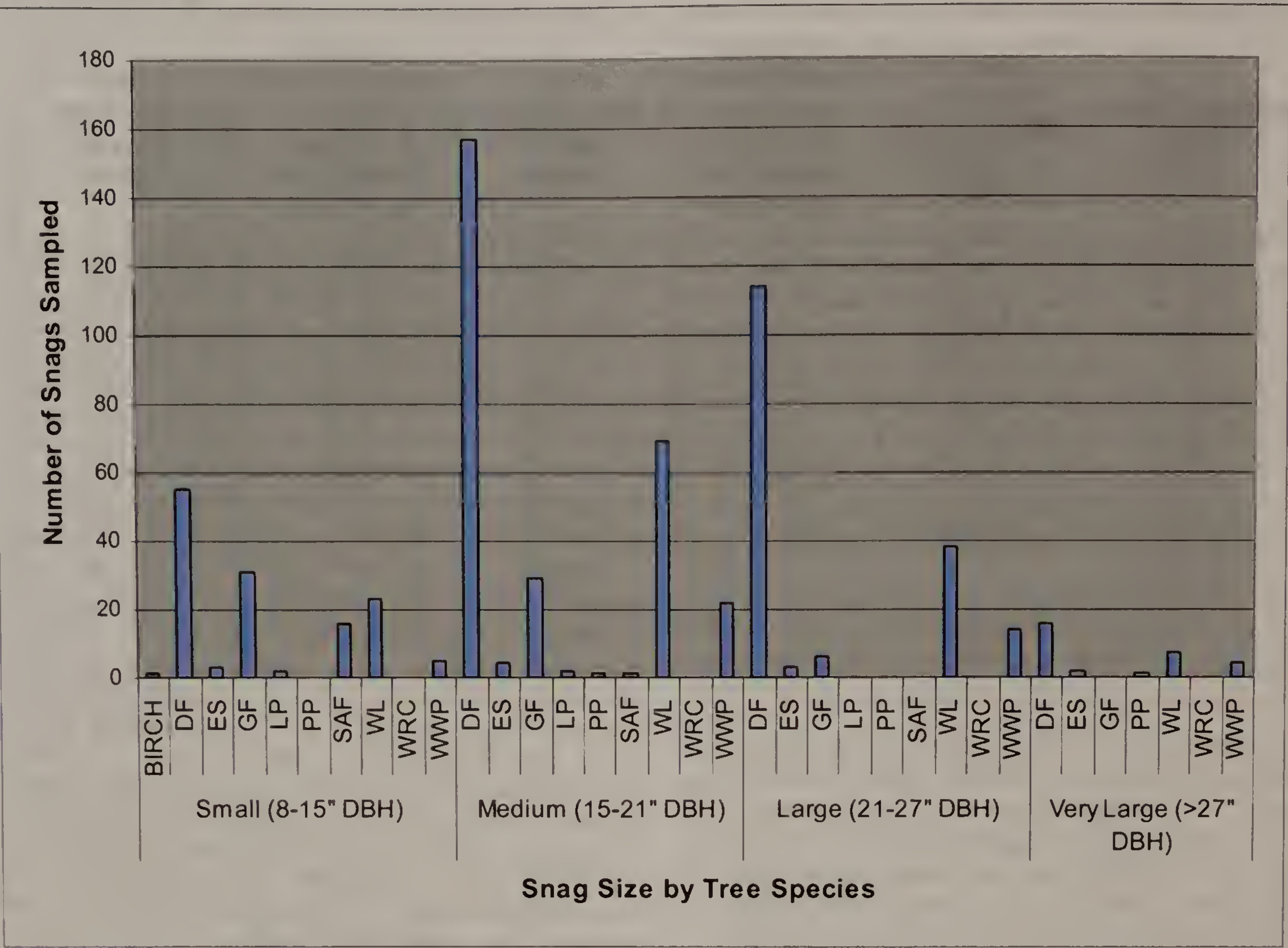
| HABITAT TYPE GROUP | ACRES IN PROJECT AREA (OVER 40 YEARS OLD) | AVERAGE LARGE SNAG DENSITY ESTIMATE BASED ON SLI DATA | TOTAL ESTIMATED LARGE SNAGS | AVERAGE MEDIUM SNAG DENSITY ESTIMATE BASED ON SLI DATA | TOTAL ESTIMATED MEDIUM SNAGS |
|---|---|---|---|---|---|
| B | 80 | 1.0 | 80 | 10.0 | 800 |
| C* | 90 | 5.5 | 495 | 5.5 | 495 |
| D | 4,775 | 3.5 | 16,713 | 7.6 | 36,290 |
| E | 3,789 | 4.0 | 15,156 | 5.8 | 21,976 |
| G | 75 | 1.7 | 128 | 10.0 | 750 |
| H | 228 | 1.7 | 388 | 4.5 | 1,026 |
| I | 69 | 2.0 | 138 | 9.7 | 669 |
| J | 30 | 2.0 | 60 | 11.0 | 330 |
| Total | 10,636 | | 33,158 | | 62,336 |
| Average snags/acre | | | 3.12 | | 5.86 |

of insects and diseases, thereby increasing the snag densities experienced in the analysis area.

In addition to SLI data, snag data was collected in areas where SLI data indicated the stand might meet the old-growth definition of *Green et al. (1992)* and in other areas of interest using 1/5-acre fixed plots (data summaries can be found in the project file). Additional sampling was employed to gain a better understanding of the snag resources in stands being considered for harvests. Of the snags sampled, Douglas-fir, grand fir, and western larch were the most prevalent tree species encountered. In the larger (greater than 21 inches dbh) and medium (15 to 21 inches dbh) size classes, western larch and Douglas-fir provide the majority of snags, with western white pine the third most encountered snag species. Conversely, a majority of the smaller size class consists of Douglas-fir and grand fir snags. Small amounts of subalpine fir, Engelmann spruce, lodgepole pine, ponderosa pine, and western red cedar were noted and occurred across the size classes. The abundance of shade-intolerant snag species in the large size classes reinforces the effects of age and insect and disease agents afflicting mortality on these species. In the smaller size class, grand fir is becoming a more prevalent snag species, indicating a shift in proportions of shade-intolerant to shade-tolerant tree species in the analysis area (*FIGURE F-6 - SUMMARY OF SNAGS BY SIZE CLASS AND BY SPECIES SAMPLED WITHIN THE ANALYSIS AREA*).

To estimate snag losses for each stand proposed for harvesting under the action alternatives, the anticipated amount of snag loss was subtracted from the estimated amount of snags existing from *TABLE F-5 - ESTIMATED EXISTING SNAG ABUNDANCE AND DENSITIES IN THE ANALYSIS AREA USING SLI DATA*. Snag loss was estimated based on the best site-specific data. More rigorously collected sampling plot data is believed to provide better site-specific estimates than the SLI data. So, where sampling data were present (see the project file for stands sampled and summarized data), the mean snag density was used to assess the snag loss and retention in that harvest unit. Where sampling data were lacking, the mean of the SLI snag density for the specific habitat type group was used

*FIGURE F-6 - SUMMARY OF SNAGS BY SIZE CLASS AND BY SPECIES SAMPLED WITHIN THE ANALYSIS AREA*




*Birch = Paper, water, or bog birch*
*DF = Douglas-fir*
*ES = Engelmann spruce*
*GF = Grand fir*
*LP = Lodgepole pine*
*PP = Ponderosa pine*
*SAF = Subalpine fir*
*WL = Western larch*
*WRC = Western red cedar*
*WWP = Western white pine*

to assess snag loss and retention. Under all action alternatives, a minimum of 2 snags and 2 snag-recruit trees greater 21 inches dbh would be retained (*ARM 36.11.411*) in all harvest units. If not enough snags larger than 21 inches dbh are available, then the balance needed to meet the 2 snag/acre rule would be retained from the medium size class. The number of the snags needed to meet retention guidelines was removed from the calculated snag loss, with the assumption that all other snags in the harvest unit would be harvested. This assumption likely underestimates snags that would remain since additional snags could be retained in retention patches required for grizzly bear cover and scattered throughout the units. However, the number of additional snags to be retained and the number lost through various attrition sources are not known. Therefore, to assess the effects of these alternatives, the minimum retention requirements under *ARM 36.11.411* were assumed to disclose the maximum level of effect due to snag loss. Any retention of additional snags would lessen the effects stated.

Predicted Effects to Snag Structure

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Snag Structure***

No changes in snag density would occur due to timber-harvesting activities. Tree mortality, especially in shade-intolerant tree species, could increase due to the age of the stands, insect infestations and disease infections, or other natural events. This situation would continue to increase snag densities in the analysis area. Presently, average snag densities in Habitat Type Group D and E, which make up the majority of habitat-type groups in the project area, show elevated densities of snags in the larger size classes. A majority of these snags are western larch and Douglas-fir. Full retention of these snag densities is expected to benefit or retain current habitat for species that use deadwood resources in the short term. In the longer term, shade-intolerant snag species are expected to decline and not be replaced due to the lack of reproduction of these species in the analysis area. The reduction in shade-intolerant species, over time, could reduce nesting structure and available cavities for secondary cavity users. The increase in shade-tolerant species is expected to contribute to snag densities through time. However, since the length of time between shade-tolerant tree species becoming soft enough for cavity excavation and the time they fall to the ground is relatively short compared to shade-intolerant species, the length of time that these snag species provide secondary cavity-nesting habitat are expected to be relatively short term.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Snag Structure***

In all units proposed under these alternatives, decreases in feeding and nesting sites are expected to occur due to the harvesting of snags (*FIGURE F-6 - SUMMARY OF SNAGS BY SIZE CLASS AND BY SPECIES SAMPLED WITHIN THE ANALYSIS AREA*). Within the harvest units, a minimum of 2 snags per acre would be retained. If adequate preharvest large-snag densities exist in the harvest units, these snags would be retained from the large-size class. In the event that adequate densities of preharvest snags are lacking, all large snags would be retained with the balance needed to meet *ARM 36.11.411* being retained from the medium-size class. All retention snags would be marked to leave. If snags planned for retention were felled for safety concerns, these snags would be left on site and/or a replacement snag could be designated to leave for the purpose of providing feeding substrate and habitat structure for wildlife species. Operational and safety losses of retention snags are expected to be higher in the cable and helicopter units as compared to the ground-based units due to safety concerns relating to sawyers and other workers being injured from an increased risk of knocking over snags while yarding the trees from the steep units. In these units, close sale administration would be needed to ensure snag-retention requirements are met.

The retention of 2 snags per acre in the large size class approximates the densities reported by *Harris (1999)*; therefore, densities of large snags would decrease under these alternatives, but the approximate historical average density would be retained within each harvest unit. Therefore, nesting and foraging sites would be reduced to near-average historic levels resulting in a low risk of decreasing survival or reproduction of species that need large snags to fulfill their life requirements. However, the heavy reduction in densities of medium and small snags could result

in moderate risks to decreasing foraging and feeding opportunities by cavity-nesting species, resulting in reduced survival and reproduction in the harvest units. These effects are likely to last for 80 to 100 years in regeneration units and 20 to 50 years in commercial-thin units, at which time leave trees could start appreciably contributing to snag development.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Snag Structure***

Large- and medium-sized snags would be harvested from units within the analysis area. A majority of these trees would be Douglas-fir and grand fir, which primarily are used for feeding (*Bull et al. 1997*). Even after considering the reductions in snag abundance under this alternative (*TABLE F-6 - MINIMUM SNAGS DENSITIES [SNAGS/ACRE] WITHIN THE ANALYSIS AREA (THREE CREEKS TIMBER SALE PROJECT AREA) FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE*), snag densities in the analysis area would still be substantially more than would be expected by applying the average densities found in western Montana by *Harris (1999)* for large (0.89 snags/acre) and medium (2.73 snags/acre) snags. Therefore, habitat attributes of adequate large and medium snags would be retained in the analysis area, albeit reduced. Based on the existing high densities of snags in the analysis area, the reduction expected under any alternative would not likely affect the ability of the analysis area to support species that require snag structure. However, the reduction in snag structure and forest modification caused by the proposed harvesting could lead to habitat shifts away from the harvest units. These shifts could result in lower use of the harvest units and higher use of other areas within the analysis area that contain higher densities of snags and denser canopy closures. In some cases, these shifts could reduce the number of individuals that live and breed in the analysis area. In the long-term (80 to 100 years), the regeneration units are expected to start contributing shade-intolerant snag structure that would otherwise be reduced in the analysis area due to the lack of current reproduction. The increased production of snags of shade-intolerant species could result in benefits to cavity-nesting species by increased high-quality nesting structure.

No other projects are planned at the present time or within the foreseeable future within the analysis area. Public firewood cutting occurs in the analysis area and is generally confined to sites adjacent to open roads. Due to the high amount of dead and dying trees

***TABLE F-6 - MINIMUM SNAGS DENSITIES (SNAG/ACRE) WITHIN THE ANALYSIS AREA (THREE CREEKS TIMBER SALE PROJECT AREA) FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE***

| | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Estimated historic density of medium snags *(Harris 1999)* | 2.73 | 2.73 | 2.73 | 2.73 | 2.73 |
| Average density of medium snags following harvests (15-21" dbh) | 5.86 | 5.13 | 5.12 | 4.93 | 4.81 |
| Percent reduction of medium snags | 0% | 12.5% | 12.7% | 15.9% | 18.0% |
| Estimated historic density of large snags (*Harris 1999*) | 0.89 | 0.89 | 0.89 | 0.89 | 0.89 |
| Average density of large snags following harvests (<21" dbh) | 3.12 | 2.79 | 2.85 | 2.78 | 2.79 |
| Percent reduction of large snags | 0% | 10.5% | 8.8% | 10.7% | 10.5% |

in the area and the limited access into the analysis area, firewood cutting is expected to result in small reductions of snags that result in negligible cumulative effects.

Considered in conjunction with other past, present, and future activities, each of the proposed action alternatives would likely result in minor cumulative effects to snag structure due to the retention of high densities of snags (large and medium size classes) in adjacent stands and the retention of the historical average density of large snags within the harvest units.

## FINE-FILTER ANALYSIS

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species listed under the Endangered Species Act, species listed as sensitive by DNRC, and species managed as big game by DFWP.

### *THREATENED AND ENDANGERED SPECIES*

- **Bald Eagle**

  No bald eagle nests are in the area, and bald eagles do not regularly inhabit the project area. Since no effects to bald eagles or their habitat are expected under any alternative, bald eagles were dropped from further analysis.

- **Canada Lynx**

  ***Issue***

  Activities associated with timber harvesting could result in displacement of lynx from suitable habitat, which could lessen their ability to acquire adequate prey and/or successfully reproduce.

  ***Dismissed***

  All Action Alternatives would result in increased human presence and disturbance associated with timber-harvesting activities. Because lynx appear to be relatively tolerant of human presence and road use (*Mowat et al 2000*), and do not appear to avoid roads at low traffic volumes (*Ruediger et al. 2000*), none of the action alternatives are expected to result in displacement or increase the energetic cost of individual lynx. Therefore, all alternatives are expected to result in very minor risks of displacing lynx from suitable habitats that could reduce their ability to survive and reproduce in the analysis area.

  ***Issue***

  Timber harvests would remove canopy closure or alter stand conditions, which could result in the reduction or modification of habitat components leading to decreased ability for the area to support lynx.

  ***Existing Condition***

  Canada lynx are listed as "threatened" under the *Endangered Species Act*. Currently, no recovery plan exists for Canada lynx, but a draft recovery plan outline has been written (*USFWS 2005*) and is being further developed and considered by the USFWS. In addition, the USFWS published a draft rule proposing designation of critical habitat for Canada lynx. DNRC-managed lands within the project area, which occur above 4,000 feet elevation, are included in the proposed critical habitat designation. The USFWS was instructed through a court order to propose critical habitat by November 1, 2005 and to issue a final rule for critical habitat by November 1, 2006 (*Fed. Reg. Vol. 70, no. 216 Nov. 9, 2005*). If critical habitat is designated for a species, *section 7(a)(2)* of the *Endangered Species Act* requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence

of such a species or destroy or adversely modify its critical habitat. Requirements associated with designation of critical habitat for lynx would not be implemented until after formal adoption of the final rule, which is currently scheduled to occur by November 1, 2006. The rule does not apply to State agencies, unless they are conducting activities that require Federal funding or Federal permitting. Due to the critical habitat proposal being in the draft stage of the process, the fact that the designation could change substantially following the public comment stage of the process, and the fact that no Federal permitting or funding would be associated with this project, DNRC anticipates that no aspect of this project or selection of any of the proposed action alternatives would be affected by the draft critical habitat rule for Canada lynx.

Lynx are associated with subalpine fir forests in western Montana (*Ruediger et al. 2000*). Lynx habitat in western Montana consists primarily of coniferous forest with plentiful snowshoe hares, stands with abundant coarse woody debris for denning and cover for kittens, and dense forested cover for travel and security. Additionally, mature forests provide habitat for red squirrels, an alternative prey source. These conditions are found in a variety of habitat types, particularly within the subalpine fir series (*Pfister et al 1977*).

The South Fork Lost Soup Subunit was used as the analysis area to assess the effects of this project on lynx. This scale of analysis approximates the home range size of a lynx (*Ruediger et al. 2000*). The 29,884-acre South Fork Lost Soup Subunit is comprised of 18,327 acres (61.3 percent) of State trust lands, 11,010 acres (36.8 percent) of USFS, 408 acres (1.4 percent) of private, and 139 acres (0.5 percent) of lands managed by Plum Creek Timber Company. The project area is located on the eastern portion of the DNRC-managed lands in the analysis area. This area occurs on the slopes above the valley bottom and continues into the higher elevations. The changes proposed under each alternative are considered at the cumulative-effects analysis area in addition to other past, present, and foreseeable future actions that could affect lynx habitat.

To assess lynx habitat, the DNRC lynx mapping protocol was applied to SLI data to determine the amount and proportions of lynx habitat elements present in the cumulative-effects analysis area. Lynx habitat (*ARM 36.11.403(40)*) was assigned to a stand if the SLI data indicated habitat types (*Pfister et al. 1977*) that are consistent with those reportedly used by lynx (*Ruediger et al. 2000*). Lynx habitat was further broken down into 5 specific habitat elements:

1) denning,
2) young foraging,
3) mature foraging,
4) "other" habitat, and
5) temporary non-lynx habitat using stand characteristics such as stand age, canopy cover, amount of coarse woody debris, etc.

Denning habitat provides important structure needed to provide denning sites and security for juvenile lynx, while foraging habitat is critical for the survival of both adult and juvenile lynx. "Other" habitat is a general habitat category that provides for secondary prey items and contains modest levels of forest structure usable by lynx. Temporary non-lynx habitat consists of nonforest and open forested stands that are not expected to be used by lynx until

adequate horizontal cover reestablishes.

DNRC-managed lands support lynx habitat on 14,457 acres (78.9 percent of DNRC-managed lands within the South Fork Lost Soup Subunit analysis area). The current distribution of lynx habitat elements on DNRC-managed lands is a result of, primarily, past timber harvesting and the lack of recent wildfire activity (*FIGURE F-7 - EXISTING DISTRIBUTION OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS AND POTENTIAL LYNX HABITAT ON ADJACENT LANDS*). Forest-management practices over the past 40 to 60 years produced the current amount of temporary unsuitable and young foraging habitat. Stands that were precommercially thinned on DNRC-managed lands would be considered "other" habitat and not young foraging habitat in accordance with the DNRC lynx-mapping protocol. Harvests conducted over 15 years ago likely recovered to the point of at least providing "other" habitat. In addition, the lack of fire, including the effects of fire suppression, led to the development and maintenance of mature foraging, "other", and denning habitat. The resulting acreage and proportions of the DNRC lynx-mapping protocol are shown in *TABLE F-7 - EXISTING ACREAGE AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE SOUTH FORK LOST SOUP SUBUNIT CUMULATIVE-EFFECTS ANALYSIS AREA*. Specific lynx use of the analysis area is unknown. However, modeling indicates that lynx habitat is available in adequate proportions and lynx tracks have been documented on several occasions in the South Fork Lost Creek and Soup Creek drainages (*T. Their, DFWP, pers.comm. 2/14/06; M. Parker, Northwest Connections, pers. comm. 11/18/05*). This evidence

***FIGURE F-7 - EXISTING DISTRIBUTION OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS AND POTENTIAL LYNX HABITAT ON ADJACENT LANDS***

*TABLE F-7 - EXISTING ACREAGE AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE SOUTH FORK LOST SOUP SUBUNIT CUMULATIVE EFFECTS ANALYSIS AREA*

| LYNX HABITAT ELEMENT | DNRC-MANAGED LANDS WITHIN THE SOUTH FORK LOST SOUP SUBUNIT ANALYSIS AREA (PERCENT OF LYNX HABITAT) |
|---|---|
| Denning | 1,868 (12.9%) |
| Mature foraging | 4,591 (31.8%) |
| Other | 6,573 (45.5%) |
| Temp nonhabitat | 1,371 (9.5%) |
| Young foraging | 54 (0.4%) |
| Grand Total | 14,457 (100.00%) |

indicates that lynx could be using, or at least traveling through, the analysis area.

The past management actions on adjacent lands in the subunit tend to follow those discussed above for DNRC-managed lands. Based on interpretation of aerial photographs, approximately 8,909 acres of adjacent lands provide forested habitats with greater than 40-percent canopy closure, providing stand conditions that could support lynx habitat. The remaining 2,648 acres is comprised of regenerating timber stands and natural openings. A portion of these regenerating timber stands and natural openings likely provide some level of foraging habitat for lynx.

***Predicted Effects to Canada Lynx***

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Canada Lynx***

  No lynx habitat would be affected in the project area. Additionally, no other projects are expected to alter the distribution of habitat elements on State or adjacent ownerships. Therefore, in the short-term, no changes in habitat elements are expected within the cumulative-effects analysis area. In the longer term (barring natural disturbances), temporary non-lynx habitat (1,371 acres) could develop into young foraging habitat or "other" habitat. Concurrently, young foraging habitat (54 acres) could mature into "other" habitat. The amount of developing young foraging habitat (1,371 acres) is expected to exceed the amount of young foraging habitat that would mature into "other" habitat. Therefore, snowshoe hare prey availability is expected to increase within the next 10 to 20 years. However, after this time period, young foraging habitat is expected to decline because no regenerating stands would replace the stands succeeding out of young foraging habitat. When this occurs, habitat quality for snowshoe hares could decline, thereby reducing the availability of prey for lynx. As these young foraging stands mature, habitat for red squirrels could increase, slightly lessening the effect of reduced snowshoe hare prey. However, a diet of red squirrels might not provide the nutrients needed for the successful reproduction and rearing of kittens (*Koehler 1990*). Mature foraging and denning habitats are expected to remain at current proportions or increase in the future as shade-tolerant trees develop in the understory and coarse woody debris accumulates through time due to natural events. "Other" habitat is expected to increase in the future as temporary non-lynx and young foraging habitat matures into this habitat

element. Therefore, in the short term, no effects to lynx are expected. In the longer-term, without disturbance, young foraging opportunities could decrease. However, mature stands that contain dense horizontal cover could offset or compensate for these loses.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Canada Lynx***

Each alternative would alter lynx habitat in the analysis area. Harvests using seedtree, seedtree-with-reserves, and shelterwood prescriptions are expected to remove canopy and horizontal cover to prepare for regenerating trees. These prescriptions would convert available lynx habitat elements to temporary non-lynx habitat. Conversely, commercial-thin prescriptions would retain greater than 40-percent canopy cover, thereby converting any specific lynx habitat element into the "other" category. Existing young foraging habitat would not be affected *(TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE-EFFECTS ANALYSIS AREA)*. All treated acres affected would retain 15 to 20 tons of coarse woody debris and 1 slash pile per harvest unit on site to provide some horizontal and security structure for lynx. In harvest units adjacent to open roads, slash piles would not be left due to public safety concerns. In the short-term, lynx would likely avoid harvest units that were converted to temporary non-lynx habitat, resulting in habitat usage shifts away from the regeneration units. Use of the commercial-thin units is expected to continue at some level.

***TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA***

| CHANGES TO LYNX HABITAT CAUSED BY TREATMENTS | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Denning Habitat converted to Temporary Non-Lynx Habitat | 0 | -163 | -145 | -171 | -105 |
| Mature Foraging Habitat converted to Temporary Non-Lynx Habitat | 0 | -217 | -4 | -456 | -460 |
| Other Habitat converted to Temporary Non-Lynx Habitat | 0 | -97 | -275 | 21 | -54 |
| *Total increase in Temporary Non-Lynx Habitat* | *0* | *+477* | *424* | *605* | *618* |
| Denning Habitat converted to Other Habitat | 0 | 0 | 0 | -85 | 0 |
| Mature Foraging Habitat converted to Other Habitat | 0 | -71 | 0 | -107 | -136 |
| Other Habitat treated but remaining as Other Habitat | 0 | 83 | 83 | 25 | 160 |
| *Total Other Habitat resulting from treatments* | *0* | *154* | *83* | *217* | *296* |
| Changes to Young Foraging Habitat | 0 | 0 | 0 | 0 | 0 |
| *Total Lynx Habitat Affected* | *0* | *632* | *507* | *823* | *914* |

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Canada Lynx***

  Each alternative alters the amounts and proportions of lynx habitat elements in the analysis area. Denning habitat would be reduced under all alternatives (*TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA* ). However, following implementation of each alternative, enough lynx denning habitat would be retained on DNRC-managed lands to satisfy DNRC's commitment of retaining 5-percent lynx habitat in the denning-habitat element (*ARM 36.11.435*). (*TABLE F-9 - ACRES AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE CUMULATIVE EFFECTS ANALYSIS AREA [SOUTH FORK LOST SOUP SUBUNIT] FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE*). No other DNRC concurrent or foreseeable future projects are expected to alter denning habitat in the analysis area. In addition to denning habitat on DNRC-managed lands, denning habitat is likely to occur within some portion of the 8,909 acres of adjacent lands, thereby adding to the amount of denning habitat in the analysis area. None of this potential habitat on adjacent lands is planned for harvesting in the near future (2007 to 2009). In addition, insects and diseases continue to cause mortality of trees in the area, which could lead to the additional development of denning habitat. Conversely, public firewood harvesting could reduce denning structure primarily along open roads. Implementation of any of these alternatives presents a low risk of interfering with reproduction of lynx in the analysis area.

  All alternatives would reduce mature foraging habitat and would not change young foraging habitat on 54 acres *(TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA)*. Following implementation of this alternative, adequate proportions of foraging habitat on DNRC-managed lands would be retained *(TABLE F-9 - ACRES AND*

***TABLE F-9 - ACRES AND PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE CUMULATIVE EFFECTS ANALYSIS AREA (SOUTH FORK LOST SOUPSUBUNIT) FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE***

| LYNX HABITAT ELEMENT | ACRES OF LYNX HABITAT (PERCENT OF LYNX HABITAT) ELEMENTS FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE CONSIDERED | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Denning | 1,868 (12.9%) | 1,705 (11.8%) | 1,723 (11.9%) | 1,612 (11.2%) | 1,763 (12.2%) |
| Mature foraging | 4,591 (31.8%) | 4,303 (29.8%) | 4,587 (31.7%) | 4,028 (27.9%) | 3,995 (27.6%) |
| Other | 6,573 (45.5%) | 6,547 (45.3%) | 6,298 (43.6%) | 6,744 (46.7%) | 6,655 (46.3%) |
| Temporary nonhabitat | 1,371 (9.5%) | 1,848 (12.8%) | 1,795 (12.4%) | 1,976 (13.7%) | 1,989 (13.8%) |
| Young foraging | 54 (0.4%) | 54 (0.4%) | 54 (0.4%) | 54 (0.4%) | 54 (0.4%) |
| *Total lynx habitat* | *14,457* | *14,457* | *14,457* | *14,457* | *14,457* |

*PROPORTIONS OF LYNX HABITAT ELEMENTS ON DNRC-MANAGED LANDS IN THE CUMULATIVE EFFECTS ANALYSIS AREA [SOUTH FORK LOST SOUP SUBUNIT] FOLLOWING IMPLEMENTATION OF EACH ALTERNATIVE).* Implementation of any alternative satisfies DNRC's commitment to foraging habitat under ARM 36.11.435. In addition to foraging habitat on DNRC-managed lands, foraging habitat is likely to occur within some portion of the 8,909 acres with greater than 40-percent canopy cover and the 2,648 acres of open forest (assuming that they have adequate horizontal cover) of adjacent lands. None of this potential habitat on adjacent lands is planned for harvesting in the near future (2007 through 2009). In 10 to 20 years, acres converted to temporary non-lynx habitat are expected to regenerate into young forage, which would result in an increase in foraging habitat available in the analysis area. Therefore, all alternatives would result in a low risk of reducing foraging opportunities to the point where a lynx could not survive in the area, and, in the longer-term, this alternative could result in a minor beneficial effect by increasing foraging habitat for 10 to 30 years.

In the short-term, available lynx habitat would be converted to temporary non-lynx habitat on DNRC-managed lands in the analysis area *(TABLE F-8 - ACREAGE CHANGES IN LYNX HABITAT ELEMENTS FOLLOWING IMPLEMENTATION OF THE ALTERNATIVES CONSIDERED ON DNRC-MANAGED LANDS WITHIN THE CUMULATIVE EFFECTS ANALYSIS AREA).* No other DNRC project or projects on adjacent lands are expected to convert any additional suitable lynx habitat to temporary non-lynx habitat; therefore, no additional habitat conversion is expected. As these stands regenerate young trees in 10 to 20 years, young foraging habitat is expected to develop. This habitat element provides habitat for snowshoe hares, which, in turn, lynx prey upon. Regenerating stands provide high quality snowshoe hare habitat until the branches of the trees no longer provide horizontal cover at the ground or snow level, which is expected to occur in 10 to 30 years following successful regeneration of young trees. If these regenerating stands were precommercially thinned prior to this point, or if regeneration was less dense, they would be considered "other" habitat. In either case, the amount of temporary non-lynx habitat would decrease. Some portion of the existing 1,371 acres (9.5 percent) temporary non-lynx habitat would likely convert to young foraging or other habitat in the near future, thereby offsetting the loss of habitat under these alternatives to some degree. Regardless of the conversion of existing temporary non-lynx habitat to usable habitat, each alternative, in combination with other activities in the analysis area, is expected to retain enough usable habitat for a lynx to survive and reproduce in the analysis area. Therefore, there would be a low risk of preventing lynx use and reproduction in the analysis area under any of the action alternatives.

All action alternatives would result in a short-term reduction in lynx habitat. However, adequate amounts of habitat in suitable proportions of habitat (denning and foraging habitat) would be retained. In 10 to 20 years, each action alternative could result in increased young

foraging habitat that could provide increased snowshoe prey availability for 10 to 30 years. Therefore, all action alternatives are expected to result in a low risk of reducing the ability of a lynx to survive and reproduce in the area in the short-term (10 to 20 years), and could benefit lynx in 10 to 20 years by increasing foraging habitat as the harvested stands regenerate and provide snowshoe hare habitat.

Other actions that may occur in the analysis area that could be cumulative to the proposed alternatives include the continued effects from insect and disease agents, future harvesting activities on neighboring ownerships, fire suppression, and bobcat trapping.

Concurrently, insect and disease agents continue to kill trees in the analysis area, which results in increased recruitment of coarse woody debris, resulting in a possible increase in den sites. Public firewood cutting (usually adjacent to open roads) on all ownerships would reduce recruitment of coarse woody debris in those areas. However, the removal of dead and dying trees are not expected to appreciably alter the amount of suitable lynx habitat, but could reduce local accumulations of coarse woody debris available for denning sites and the development of denning habitat. However, denning habitat does not appear to be limiting in the subunit; therefore, no substantial additional effects are expected in addition to the effects discussed under each alternative above.

No additional harvesting activities are planned on neighboring ownerships in the cumulative-effects analysis area during the 3-year active period. However, fire-suppression activities would continue to reduce the potential for stand-replacing wildfires, which could limit the natural development of young foraging habitat in the future. Therefore, the only foreseeable potential for the development of young foraging habitat would be through the proposed harvests.

Currently, 1 trapper has a permit to lawfully set traps for bobcats, consistent with DFWP trapping regulations, on DNRC-managed lands in the analysis area. Incidental captures are possible, but not expected. In the event that a lynx is captured, the trapper is obligated to release the animal without harm. Therefore, no additional impacts from trapping are expected.

Considered in conjunction with other past, present, and future activities, any of the proposed action alternatives would likely result in minor cumulative effects to Canada lynx.

- **Gray Wolf**

***Issue***

Gray wolves could be affected by disturbance at key locations (denning/rendezvous sites) during harvesting, which could result in an increased risk to wolf pups.

***Dismissed***

Wolves are most vulnerable to human disturbance at den and rendezvous sites from April to September. Denning and rendezvous sites are unlikely to occur in the project area due to the steep topography and the presence of more suitable den sites outside the project area in the nearby valley bottom. If a wolf den were located, DNRC would temporarily suspend all mechanized activities and administrative uses, over which DNRC has control, in areas

that are within a one-mile radius of the den until such time as wolves are known to have vacated the site or it has been determined that resumption of activities would not present conflicts with wolf use (*ARM 36.11.430[1][a][i]*). Harvesting activities would generally occur outside of the spring period (April 1 through June 15), thereby further limiting the risk of disturbance to wolves at den sites. When harvests become active in mid-June, wolves would likely have moved their pups to rendezvous sites, where human disturbance could also be harmful. If a rendezvous site were located, DNRC would temporarily suspend operations within 0.5 mile of the site until it is determined that resumption of activities will not present conflicts with wolf use (*ARM 36.11.430[1][b]*). With these mitigations in place, this project is not expected to disrupt wolves at key locations. Therefore, a negligible risk to wolf pups would be expected under any alternative.

***Issue***

Gray wolves could be adversely impacted through increased motorized access due to road construction and a reduction in hiding cover, which could result in increased risk of human/wolf conflicts and subsequent mortality of wolves.

***Issue***

Timber harvesting could alter habitat and reduce the ability of the project area to support wolves by decreasing the carrying capacity of the winter range for native ungulates.

***Existing Condition***

The gray wolf is listed as "endangered" under the Endangered Species Act in the northern portion of Montana, which includes the project area. To meet the delisting criteria, the 3 recovery areas need to support a minimum of 30 breeding pairs for 3 consecutive years. The 3 recovery zones have met the recovery objectives for breeding pairs since 2000. In 2005, 71 packs were documented within the tri-state region (*USFWS et al. 2006*). Of those 71 packs, 46 occurred in Montana, with 19 of those found in northern Montana portion of the recovery area (*Sime et al. 2006*). The delisting process is ongoing, and DFWP has assumed lead management authority over the species in Montana.

The wolf is a wide-ranging, mobile species. Adequate habitat for wolves consists of areas with adequate prey and minimal human disturbance, especially at den and/or rendezvous sites. Wolves prey primarily on white-tailed deer, and, to a lesser extent, elk and moose, in northwest Montana (*Kunkel et al. 1999*). Wolves typically den during late April in areas with gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas. When the pups are 8 to 10 weeks old, wolves leave the den site and start leaving their pups at rendezvous sites while hunting. These sites are used throughout the summer and into the fall. When the pups are 5 to 6 months old, they start traveling with the pack (*DFWP 2003*). Disturbance at den or rendezvous sites could result in avoidance of these areas by the adults or force the adults to move the pups to a less adequate site. In both situations, the risk of pup mortality increases.

To analyze the cumulative effects to wolves, the South Fork Lost Soup Subunit was used. This analysis area represents the amount of area that a wolf pack may use during the summer months while raising their pups (*Mech 1987, Ream et al. 1988*). Therefore, if a denning site

occurred in the analysis area, wolf use would likely remain within the analysis area. Outside the denning and rearing period, the pups travel with the pack and home ranges can expand greatly (*Mech 1970, FWP 2003, USFWS et al. 2006*). The South Fork Lost Soup Subunit includes the project area and the valley floor, which contains approximately 6,613 acres of elk and mule deer composite winter range. No white-tailed deer winter range occurs in this subunit. Wolf tracks and sightings have occurred in and near the project area within the last 2 years; however, no denning activity has been documented (*USFWS et al. 2006, K.Lauden, pers.comm.3/20/06*). Transitory or sporadic wolf use is expected to continue in the project area. Due to the topography and the lack of white-tailed deer winter range, denning and rendezvous sites are not expected to occur within the project area, but may be established in the valley bottom where habitat conditions are favorable. Wolf use of the project area would probably be associated with foraging or traveling activities.

In addition, this subunit is cooperatively managed for grizzly bear habitat and access. Actions taken by the cooperators to manage motorized access, hiding cover, visual screening along open roads, and spring harvest restrictions to project grizzly bears also benefit wolves. Currently, 31.2 percent of the analysis area exceeds 1 mile per square mile open-road density and 79 percent of the analysis area provides hiding cover. In addition, 49.6 miles of restricted road occurs within the cumulative-effects analysis area. Cattle and sheep grazing operations can be a source of human/wolf conflict; however, no livestock grazing leases or licenses occur within the cumulative-effects analysis area.

***Predicted Effects to Gray Wolves***

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Gray Wolves***

The existing vegetation and human access in the project area are not expected to be altered; therefore, no effects on wolves are expected.

- ***Direct and Indirect Effects to Gray Wolves Common to Action Alternatives B, C, D, and E***

The risk of human/wolf conflicts and/or wolf mortality in the project area could be increased through additional human access and reduced hiding cover attributable to new road construction and logging operations. Under all alternatives, a range of 8.4 to 15.8 miles of new restricted road would be constructed to harvest the proposed units. Any new road would be managed as restricted, except for the new portion (1.7 miles) of South Fork Lost Creek Road. The old portion of this open road would be abandoned (1.3 miles). Timber harvesting could remove between 1,203 and 1,351 acres of hiding cover for 10 to 20 years, depending on the alternative chosen (*TABLE F-10 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF PERMANENT RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE*). To mitigate the risks associated with increased human access during logging operations and the reduction of hiding cover, regeneration units would be laid out, so that no point of any regeneration unit would be greater than 600 feet to cover, visual screening would be retained between open roads and regeneration units (seedtree and shelterwood harvest units), and contractors would not be allowed to carry firearms while on duty. Taken together, these mitigations are expected to

*TABLE F-10 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF PERMANENT RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE*

| PARAMETER | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Hiding cover acres removed | 0 | 1,274 | 1,203 | 1,351 | 1,322 |
| Linear miles of permanent, restricted road | 0 | 13.3 | 12.7 | 15.8 | 8.4 |

result in a low risk for human/ wolf conflicts or increased wolf mortality if wolves use the harvest units.

- ***Cumulative Effects to Gray Wolves Common to Action Alternatives B, C, D, and E***

Each alternative was analyzed at the South Fork Lost Soup Subunit analysis area level in the context of the existing condition. Under all action alternatives, open-road density would increase, hiding cover would decrease, and additional linear miles of restricted roads would be constructed, which could affect wolf use and the ability to survive in the analysis area.

Under all alternatives, the proportion of the analysis area that exceeds 1 mile per square mile open-road density would increase from 31.2 percent to 31.5 percent within the analysis area (*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE EFFECTS ANALYSIS AREA*). (Refer to the analysis on Grizzly Bear for analysis methods.) Since the increase is small and occurs due to the rerouting of a currently open road in the same area, this increase is expected to result in a low risk of increasing wolf mortality in the analysis area.

Implementation of any alternative would reduce the hiding cover in the analysis area by 4.8 to 5.4 percent for 10 to 20 years, depending on whether an action alternative is chosen and which one is chosen (*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE-EFFECTS ANALYSIS AREA*). Following implementation of any alternative, a high proportion of hiding cover (ranging from 75.2 to 74.8 percent) would still remain in the subunit. Concurrent salvage harvests on DNRC-managed lands are not expected to alter hiding cover, nor are any projects planned on adjacent lands that could reduce hiding cover.

*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE-EFFECTS ANALYSIS AREA (IE., SOUTH FORK LOST SOUP SUBUNIT)*

| PARAMETER | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Percent Open-Road Density greater than 1 mile per square mile in the South Fork Lost Soup Subunit (% increase) | 31.2% (0.0%) | 31.5% (1.0%) | 31.5% (1.0%) | 31.5% (1.0%) | 31.5% (1.0%) |
| Hiding Cover retained in the South Fork Lost Soup Subunit (% reduction) | 79% (0.0%) | 75.0% (5.1%) | 75.2% (4.8%) | 74.7% (5.4%) | 74.8% (5.3%) |
| Linear miles of restricted roads (% increase) | 49.6 (0.0%) | 62.9 (26.8%) | 62.3 (25.4%) | 65.4 (31.9%) | 58.0 (16.9%) |

Although no threshold levels of hiding cover have been established for wolves (*USFWS et al. 2006*), the thresholds developed for grizzly bears (*SVGBCA 1997*) would likely also provide adequate security for wolves. Therefore, implementation of this alternative is expected to remove hiding cover, but result in a low risk of increased mortality to wolves using the analysis area.

Additional permanent road access could lead to additional disturbance and/or mortality risk in the future. This alternative would increase the linear mileage of restricted roads from 49.6 to a range of 58.0 to 62.9 miles, a 16.9- to 26.8-percent increase (*TABLE F-11 - CHANGES BY ALTERNATIVE IN OPEN-ROAD DENSITY, HIDING COVER, AND RESTRICTED ROAD MILEAGE FOR THE CUMULATIVE-EFFECTS ANALYSIS AREA*). No other concurrent or foreseeable future projects on DNRC-managed or adjacent lands would construct new roads; therefore, only this project would increase road access. The presence and maintenance of restricted roads produces a long-term potential for additional disturbance to wolves and increased risk of wolf/human conflicts when compared to areas without road access. These disturbances would likely be associated with administrative and salvage harvests during inactive periods and could include commercial forest-management activities during active periods as dictated by the SVGBCA. Since mitigations are in place to protect key sites and restrict carrying firearms while on duty, these increases are likely to represent a negligible risk to increasing wolf mortality in the analysis area.

Overall, all alternatives protect key sites, retain considerable levels (74.7 to 75.2 percent of the analysis area) of hiding cover, maintain approximately the same level of public motorized access (small location shift of South Fork Lost Creek Road), restrict contractors from carrying firearms while on duty, and are not expected to affect big game populations (refer to the analysis on *BIG GAME*) in the analysis area. Therefore, each alterative presents a low risk to increasing mortality to wolves or substantially reducing their prey in the analysis area.

- **Grizzly Bear**

***Issue***

Activities associated with timber harvesting can alter cover, increase access, and reduce secure areas, which can adversely impact grizzly bears by displacing bears from preferred habitats and/or by increasing risk to bears of human-caused mortality.

***Existing Condition***

Grizzly bears, native generalist omnivores that use a diversity of habitats found in western Montana, are currently listed as "threatened" under the Endangered Species Act. Primary threats to grizzly bears are related to human-bear conflicts, habituation to unnatural foods near high-risk areas, and long-term habitat loss associated with human development (*Mace and Waller 1997*). Forest-management activities may affect grizzly bears by altering cover and/or by increasing access to humans into secure areas by creating roads (*Mace et al. 1997*). These actions can lead to displacement of grizzly bears from preferred areas and/or result in an increased risk of human-caused mortality by bringing humans and bears closer together and/or making bears more detectable,

which can increase their risk of being shot illegally. Displacing bears from preferred areas may increase their energetic costs, which may in turn lower their ability to survive and/or reproduce successfully.

For decades, lands in the Swan Valley have been aggressively managed for timber production, the influences of which are evident when touring the valley or viewing recent aerial photographs of the area. Evidence of past activities exists on USFS lands, corporate timberlands, and DNRC-managed State trust lands associated with the foothills and valley floor. Past activities have resulted in an obvious patchwork comprised of multiaged forest stands that are variously shaped, which exist at differing stages of successional development. Some old harvest units now contain productive berry patches and hiding cover; whereas, more recent clearcut and seedtree harvest units provide little in the way of forage or cover for bears. Other areas that have been lightly harvested, intensively harvested several decades ago, or never harvested do continue to provide ample levels of cover in the valley (*SVGBCA monitoring report 2004*). Extensive road systems that have been required over the years to facilitate intensive logging are also evident in the valley. These road systems have developed over the years and now provide a number of access routes into otherwise remote areas.

In the Swan Valley, DNRC, USFS, Plum Creek Timber Company, and the USFWS collaborated to cooperatively manage grizzly bear habitat and access under the SVGBCA. Another main objective of the SVGBCA is to ensure connectivity across Swan valley through special management of linkage zones. Preliminary evaluation of data collected from radio-collared bears indicates that the use of the valley bottom by bears is occurring to facilitate linkage between the Bob Marshall Wilderness and Mission Mountain Wilderness bear populations. However, monitoring of radio-collared bears has also indicated a trend of high mortality rates in Swan Valley, primarily attributable to illegal human-caused mortality and management removals (*SVGBCA monitoring report 2004*).

Under the SVGBCA, a rotation of active and inactive subunits was devised. The rotation schedule allows for active subunits, where harvesting activities might displace grizzly bears, and inactive subunits, where commercial activities are prohibited to provide undisturbed habitat. These rotations occur on a 3-year-active and 6-year-inactive basis. The South Fork Lost Soup Subunit was scheduled to become active during the 2006 through 2008 period. However, DNRC requested and was granted an exception to the rotation period for the South Fork Lost Soup Subunit. Based on the exception, the South Fork Lost Soup Subunit would be active for the period of 2007 through 2009. This exception requires that no commercial activities occur in the South Fork Lost Soup Subunit for the 2006 nondenning period, and no commercial activities occur on DNRC-managed lands in the Lion Creek Subunit for the 2009 nondenning period.

When a subunit is active, harvesting activities would not occur during the spring period (April 1 through June 15) in spring habitat (areas within linkage zones below 5,200 feet). After the spring period, harvesting activity and associated road use can occur unrestricted in the active subunit. However, any restricted road used for

commercial activities would require the restriction of public use through the placement of signs while harvesting activities are occurring, and placing a barrier across the road when harvesting activities are not occurring (weekends, nights, inactive periods etc.). Other stipulations under the SVGBCA include:

- retaining of a 100-foot visual buffer between open roads and the even-aged harvest units,
- utilizing uneven-aged management in the riparian zones,
- laying out harvest units so that no point is greater than 600 feet to cover, and
- restricting contractors from carrying firearms while on duty.

In addition to the above stipulations, the SVGBCA provides defined standards for hiding cover and open-road density for each subunit and requires cooperators to track amounts of total-road density and secure habitat.

Cumulative effects of the alternatives considered under this proposal were analyzed at the South Fork Lost Soup Grizzly Bear Subunit scale. All analyses required by the SVGBCA are also reported at the grizzly bear management unit subunit scale, which approximates the home range size of a female grizzly bear. For the cumulative effects analysis, other past, present, and foreseeable future actions in the South Fork Lost Soup Subunit (all cooperators) and their effects in combination with this project on hiding cover, open-road density, total-road density, and secure habitat were considered. Past projects resulting in changes to hiding cover and the construction of roads are considered in the existing condition.

The SVGBCA requires each cooperator to manage their lands so that a minimum of 40 percent of each subunit supports hiding cover. Presently, hiding cover in the South Fork Lost Soup Subunit is comprised of 82 percent of DNRC-managed, 75 percent of USFS, and 57 percent of Plum Creek Timber Company lands, averaging (weighted on acres) 79 percent for the subunit. The other defined standard in the SVGBCA is open-road density. The SVGBCA requires cooperators to manage open roads so that no more than 33 percent of the subunit exceeds 1 mile per square mile of open-road density. Open-road density is calculated by using a moving-windows-analysis technique (*Ake 1994*). Presently, 31.2 percent of the subunit exceeds 1 mile per square mile of open-road density.

The SVGBCA does not contain a total-road density or secure habitat standard, but requires the cooperators to annually report these values by subunit. To measure total-road density, a moving-windows analysis was conducted to determine that 53.4 percent of the analysis area exceeds 2 miles per square mile. To measure secure habitat, the highway, open roads, gated roads, and high-use trails were buffered by 1,640 feet (500 meters). The buffered area was then subtracted from the subunit acreage to obtain the amount of potential secure habitat in the analysis area. To be considered secure habitat, the area in question needs to exceed 2,500 acres. This analysis yielded 32.2 percent of the analysis area in secure habitat.

***Predicted Effects to Grizzly Bears***

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Grizzly Bears***

  No alteration of habitat attributes or increased human presence would occur; therefore, no changes in habitat use or human-caused mortality would be expected under this alternative.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Grizzly Bears***

Under each alternative, a range of 1,203 to 1,351 acres of hiding cover would be removed by implementation of seedtree and shelterwood silvicultural prescriptions (*TABLE F-12 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE*). To reduce the avoidance of harvest units and provide security if a bear uses the harvest unit, the seedtree and shelterwood harvest units would be laid out to ensure that no point of the unit exceeds 600 feet to cover and visual screening would be retained in a 100-foot strip between the harvest unit and an open road. With the mitigation measures in place, a low risk of avoidance of harvest units and a low risk to increased mortality while using the harvest units are expected. These effects would be expected to last until hiding cover reestablishes in 10 to 20 years.

The harvesting activities could result in short-term displacement effects, while construction of new roads could result in both short-term and long-term displacement effects. Under these alternatives, between 8.4 and 13.3 miles of new permanent roads and 3.9 to 6.6 miles of new temporary roads would be constructed (*TABLE F-12 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE*). All new permanent roads, except for 1.7 miles, would be managed as restricted. The 1.7 miles of new permanent road would be constructed to reroute the existing South Fork Lost Creek Road away from South Fork Lost Creek. Approximately 1.3 miles of the existing South Fork Lost Creek Road would then be abandoned, resulting in a 0.4 mile increase in open roads. The new permanent restricted roads would be blocked by a gate that would allow for administrative use. The new temporary roads would be blocked off with a berm (or like structure) that would prevent public and administrative motorized use. The effects of displacement during the active period (2007 through 2009) are expected to be mitigated by having inactive subunits within the Bunker Hill Bear Management Unit to provide relatively undisturbed areas for bears to displace into. Therefore, each alternative is expected to represent a minor risk to bear displacement that results in mortality. In the longer-term, bears could avoid habitat associated with the new roads, which would result in a loss of habitat. These effects will be discussed further under the cumulative effects section of this analysis.

***TABLE F-12 - PROPOSED AMOUNTS OF HIDING COVER REMOVED AND AMOUNT OF LINEAR MILES OF RESTRICTED ROAD CONSTRUCTION EXPECTED UNDER EACH ALTERNATIVE***

| PARAMETER | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres of hiding cover harvested | 0 | 1,274 | 1,203 | 1,351 | 1,322 |
| Linear miles of permanent, restricted road constructed | 0 | 13.3 | 12.7 | 15.8 | 8.4 |
| Linear miles of temporary, restricted road constructed | 0 | 5.2 | 6.6 | 3.9 | 4.6 |

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Grizzly Bears***

  Under all alternatives, the amount of hiding cover retained in the subunit would be reduced from 79.0 percent to between 74.7 and 75.2 percent (a 5.1- to 4.8-percent reduction), depending on whether an action alternative is chosen and which one (*TABLE F-13 - RESULTS EXPECTED AFTER IMPLEMENTATION OF EACH ALTERNATIVE FOR HABITAT PARAMETERS IMPORTANT TO GRIZZLY BEARS*). In any case, the hiding cover amounts greatly exceed the 40-percent stipulation required by the SVGBCA. Additionally, DNRC is concurrently considering salvage harvests on an additional 120 acres in the analysis area. These harvests are not expected to alter hiding cover, so no additional changes in hiding cover is expected on DNRC-managed lands. Other cooperators (USFS and Plum Creek Timber Company) do not have plans for projects in this subunit during the 2007 through 2009 active period. Therefore, this alternative would result in small proportional reductions of hiding cover, resulting in negligible risk of reducing availability of grizzly bear habitat or increasing mortality risks to bears using the analysis area.

  All action alternatives would increase the open-road density the same amount within the South Fork Lost Soup Subunit. The rerouting of the South Fork Lost Creek Road and the abandonment of portions of the existing roads would result in an increase in open-road density from 31.2 to 31.5 percent. This increase is within the 33-percent stipulation of the SVGBCA. The increase in open-road density is slight and within the same area already affected by this road; therefore, any additional risk of an increase in mortality or decrease in reproduction due to this change is likely to be negligible.

  The presence and maintenance of restricted roads produces a long-term potential for additional disturbance to grizzly bears and increased risk of human-caused mortality when compared to areas without road access. Under all alternatives, the proportion of area affected by total-road density would increase and secure habitat would decrease (*TABLE F-13 - RESULTS EXPECTED AFTER IMPLEMENTATION OF EACH ALTERNATIVE FOR HABITAT PARAMETERS IMPORTANT TO GRIZZLY*

***TABLE F-13 - RESULTS EXPECTED AFTER IMPLEMENTATION OF EACH ALTERNATIVE FOR HABITAT PARAMETERS IMPORTANT TO GRIZZLY BEARS (estimates are for ownership of all SVGBCA cooperators within the South Fork Lost Soup Subunit analysis area)***

| PARAMETER | SVGBC REQUIREMENTS | ALTERNATIVE | | | | |
|---|---|---|---|---|---|---|
| | | A | B | C | D | E |
| Open-road density | No more than 33% | 31.2% | 31.5% | 31.5% | 31.5% | 31.5% |
| Hiding cover retained | No less than 40% | 79.0% | 75.0% | 75.2% | 74.7% | 74.8% |
| Linear miles of restricted roads | No limit | 49.6 | 62.9 | 62.3 | 65.4 | 58.0 |
| Total-road density | No limit | 53.2% | 58.3% | 57.5% | 59.9% | 56.9% |
| Secure habitat | No limit | 32.2% | 29.7% | 30.1% | 28.9% | 30.8% |

*BEARS*). The increase in total-road density and decrease in secure habitat could result in increased disturbance of grizzly bears by nonmotorized dispersed recreation, administrative activities (including motorized), salvage harvests during inactive periods, and commercial forest-management activities during active periods. Since no stipulations for total-road density or secure habitat are noted in the SVGBCA, all alternatives are in compliance. The increase in total-road density and decrease in secure habitat could result in an increased risk of avoidance of suitable habitat and human/bear interactions. However, stipulations placed on contractors and DNRC personnel that restrict carrying firearms reduce the risk of additional mortality associated with administrative use. The availability of roads could increase nonmotorized use in the analysis area. However, this use is not expected to grow substantially; therefore, the risk to bears associated with nonmotorized use would be negligible.

Concurrent salvage harvests on DNRC-managed lands (120 acres) are not expected to remove hiding cover or construct new roads in the subunit. Additionally, no foreseeable future forest-management activities are planned on any cooperator lands in the subunit. Therefore, no cumulative effects are expected from concurrent or foreseeable future actions of other cooperators.

All alternatives fully meet the stipulations in the SVGBCA. These alternatives are expected to result in a low risk of increased bear mortality or decreased reproduction due to displacement and human-caused mortality based on:

- the retention of a high percentage of hiding cover (74.8 to 75.2 percent),
- the minor increase in open-road density (0.3 percent),
- the increase in total-road density (3.5 to 6.5 percent),
- the reduction of secure grizzly bear habitat (2.1 to 3.3 percent),
- the restrictions of firearms, and
- the availability of undisturbed habitat in the adjacent subunits.

Action Alternative D poses the greatest risk, followed by B, C, and E, respectively.

### *SENSITIVE SPECIES*

When conducting forest-management activities, SFLMP directs DNRC to give special consideration to several "sensitive" species. These species may be sensitive to human activities, have special habitat requirements, are associated with habitats that may be altered by timber management, and/or may, if management activities result in continued adverse impacts, become listed under the Federal Endangered Species Act. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met. The following sensitive species were considered for analysis. As shown in *TABLE F-14 - STATUS OF DNRC SENSITIVE SPECIES FOR NWLO IN RELATION TO THIS PROJECT*, each sensitive species was either included in the following analysis or dropped from further analysis for various stated reasons.

***TABLE F-14 - STATUS OF DNRC SENSITIVE SPECIES FOR NWLO IN RELATION TO THIS PROJECT***

| **SPECIES** | **DETERMINATION - BASIS** |
|---|---|
| Black-backed woodpecker | No further analysis conducted - No burned habitat occurs in the project area. |
| Coeur d'Alene salamander | No further analysis conducted - No moist talus or streamside talus habitat occurs in the project area. |
| Columbian sharp-tailed grouse | No further analysis conducted - No suitable grassland communities occur in the project area. |
| Common loon | No further analysis conducted - No lakes occur in or near the project area. |
| Fisher | *Included* - Potential fisher habitat occurs in the project area. |
| Flammulated owl | No further analysis conducted - No dry ponderosa pine or dry Douglas-fir habitats occur in the project area. |
| Harlequin duck | No further analysis conducted - No observations of harlequin ducks have been documented on any streams in the project area and no alternative would alter vegetation directly adjacent to the streams in the project area. |
| Northern bog lemming | No further analysis conducted - No sphagnum bogs or other fen/moss mats occur in the area. |
| Peregrine Falcon | No further analysis conducted - No potential habitat is expected in the project area. |
| Pileated woodpecker | *Included* - Western larch/Douglas-fir and mixed-conifer habitats occur in the area. |
| Townsend's big-eared bat | No further analysis conducted - No caves or mine tunnels occur in the project area. |

## ➢ Fisher

### *Issue*

Timber harvesting could reduce fisher habitat availability and quality by reducing canopy cover, snag density, and the amount of coarse woody debris. Reductions in fisher habitat quantity and quality could result in adverse effects to fishers.

### *Issue*

Timber harvesting could remove canopy cover, which may impede fisher movement within their home range, resulting in decreased ability for fishers to use the analysis area.

### *Existing Condition*

Fisher habitat consists of foraging, denning, and resting components. Fishers avoid areas with deep soft snow (*Buskirk and Powell 1994*) and are typically found below 6,000 feet in elevation (*Powell and Zielinski 1994*). Fishers are generalist predators that prey upon a variety of small mammals and birds, along with snowshoe hares and porcupines. They also take advantage of carrion and seasonally available fruits and berries (*Foresman 2001*). Fishers use a variety of successional stages, but are disproportionately found in stands with dense canopies (*Powell 1982, Johnson 1984, Jones 1991, Heinemeyer and Jones 1994*) and avoid openings or young forested stands (*Buskirk and Powell 1994*). However, some use of openings does occur for short hunting forays or if sufficient overhead cover (shrubs, saplings) is present. Fishers appear to be highly selective of stands that contain resting and denning sites (*Jones 1991*). Resting and denning sites are found in cavities of live trees and snags, downed logs, brush piles, mistletoe brooms, squirrel and raptor nests, and holes in the ground.

For cumulative effects analysis purposes, the South Fork Lost Soup Grizzly Bear Subunit scale was used (*ARM 36.11.440*). This scale includes enough area to approximate overlapping home ranges of male and female fishers (*Heinemeyer and Jones 1994*). The existing condition as it relates to fisher habitat is primarily affected by the lack of wildfire and the effects of past timber harvests. The project area and the higher elevations of the subunit consist of large patches of mature to old-growth stands that developed over time in the absence of recent stand-replacing fires. Additionally, past harvest units reduced stand age and canopy cover near the South Fork Lost Creek and Soup Creek roads and natural openings (avalanche chutes, talus slopes, etc.) near the divide between Swan Valley and the Bob Marshall Wilderness. The lower elevations of the subunit are a patchwork of past harvest units and natural openings with low amounts of canopy closure. Forested cover is primarily intact along Soup, Unnamed, Cilly, and South Fork Lost creeks and along the major ridges in the analysis area, resulting in highly connected forested stands, especially along the riparian corridors and across third-order drainages (South Fork Lost and Soup creeks).

To assess potential fisher habitat and travel cover on DNRC-managed lands in the analysis area, sawtimber stands within preferred fisher covertypes (*ARM 36.11.403 (60)*) below 6,000 feet in elevation with 40-percent or greater canopy closure were considered potential fisher habitat. Fisher habitat was further divided into upland and riparian-associated areas. In the uplands, DNRC-managed lands in the analysis area consist of approximately 9,991 acres of potential fisher habitat (*FIGURE*

*F-8 - EXISTING DISTRIBUTION OF FISHER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS.*

Fisher habitat in and near riparian areas tend to be used disproportionally more than their availability on the landscape (*Jones 1991*). DNRC manages preferred fisher covertypes within 100 feet of class 1 and 50 feet of class 2 streams, so that 75 percent of the acreage (State school trust lands only) would be in the sawtimber size class in moderate to well-stocked density (*ARM 36.11.440(1)(b)(i)*).

Moderate (40- to 69-percent canopy closure) and well-stocked (greater than 70-percent canopy closure) density designations are based on SLI data. To ensure compliance, the number of moderately to well-stocked acres of sawtimber in preferred covertypes along streams was divided by the total acres of preferred covertypes in the same area. At the South Fork Lost Soup Subunit level, 86.9 percent of the DNRC-managed acreage associated with riparian features currently supports moderate- to well-stocked densities of sawtimber.

***FIGURE F-8 - EXISTING DISTRIBUTION OF FISHER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS***

*TABLE F-15 - ACREAGE AND PERCENT OF PREFERRED FISHER COVERTYPES CONSISTING OF SAWTIMBER STANDS PROVIDING GREATER THAN 40-PERCENT CANOPY COVER IN THE ANALYSIS AREA.*

| HABITAT ELEMENT | SOUTH FORK LOST SOUP SUBUNIT |
|---|---|
| Potential habitat (% preferred upland covertypes) | 9,991 acres (77.2%) |
| Preferred covertypes (% preferred covertypes associated with stream) | 731 acres (86.9%) |
| *Total fisher habitat (% of preferred covertypes)* | 10,722 acres (70.5%) |

***Predicted Effects to Fisher***

- ***Direct, Indirect, and Cumulative Effects of No-Action Alternative A to Fishers***

  Fisher habitat, preferred covertype stocking, and connectivity would remain relatively unchanged in the short term. Fisher habitat would remain at 9,991 acres (77.2 percent) in the uplands and 731 acres (86.9 percent) associated with the riparian areas on DNRC-managed lands within the cumulative-effects analysis area. The current level of connectivity would be retained. In the longer term, fisher habitat and the percentage of fisher habitat in the uplands and associated with riparian areas would increase as stands developed more overhead cover; resting/denning structure would develop as trees increase in size, die, and fall to the ground. This alternative would result in negligible effects to fishers.

- ***Direct and Indirect Effects of Action Alternative B, C, D, and E to Fishers***

  Each alternative would harvest within potential fisher habitat. Within each harvest unit, leave trees, at least 2 large snags, and 10 to 15 tons of coarse woody debris, and 1 slash pile per unit would be retained. In seedtree-with-reserve units, a number of unharvested patches of approximately 3 acres would be retained so that no point of the unit exceeds 600 feet to cover. In Section 22, where regeneration harvesting occurs on both sides of South Fork Lost, Cilly, Soup, and Unnamed creeks (*FIGURE F-2 [through F-5] - FOREST COVER FOLLOWING IMPLEMENTATION OF ACTION ALTERNATIVE B [C, D, AND E], WHICH ALLOWS FOR CONNECTIVITY OF FORESTED HABITATS IN THE ANALYSIS AREA*), a 150-foot buffer on either side of the stream would be retained. No harvesting would occur within 25 feet of the creek. From 25 to 150 feet, harvesting would remove up to 50 percent of the trees 8-inches dbh or larger, but a minimum of 40-percent canopy cover would be retained. In other areas where harvesting would occur on 1 side of said streams, a 100-foot buffer would be used. The same mitigations would apply within this buffer. The retention of 40-percent canopy cover within these buffers would retain adequate canopy cover for fishers to use as habitat or travel cover, resulting in retaining forest connectivity along the stream.

  The harvesting proposed under all alternatives would result in reduced quantity and quality of fisher habitat by 1,760 to 1,924 acres depending on whether an action alternative were chosen, and which one (*TABLE F-16 - CHANGES IN FISHER HABITAT UNDER EACH ACTION ALTERNATIVE*). In the seedtree, seedtree-with-

*TABLE F-16 - CHANGES IN FISHER HABITAT UNDER EACH ACTION ALTERNATIVE*

| FISHER HABITAT | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres of upland habitat removed | 0 | 1,274 | 1,218 | 1,279 | 1,185 |
| Acres of upland habitat altered | 0 | 527 | 487 | 508 | 648 |
| Acres of riparian habitat altered | 0 | 83 | 55 | 84 | 91 |
| *Total acres of habitat affected* | | *1,884* | *1,760* | *1,871* | *1,924* |

reserves, and shelterwood harvest units, timber harvesting would reduce canopy closure to less than 40 percent and remove understory vegetation to provide for seedling establishment. Since fishers avoid stands with less than 40-percent canopy closure (*Jones 1991*) and areas that lack overhead cover (*Buskirk and Powell 1994*), these silvicultural prescriptions would result in a loss of habitat for 10 to 20 years. After this time, regeneration of conifer trees is expected to provide overhead cover, which would allow for fisher use. Retention of snag-recruitment trees and a minimum of 2 large snags per acre could provide denning or resting sites between the time the stands develop overhead cover and when the stands regenerate to a point of starting to produce large snags again. As stand matures in 80 to 100 years, canopy cover and additional structure in the form of large trees, snags, and coarse woody debris would reestablish. Conversely, commercial-thin units and areas within riparian buffers (including preferred covertypes) would retain a minimum of 40-percent canopy cover and would continue to be available for potential fisher habitat. Reductions in snag densities and coarse woody debris would occur, resulting in a potential decrease in habitat quality for fishers by removing denning/resting structure and prey habitat. However, mitigation measures would include retention of estimated average historic levels of large snags and coarse woody debris; thereby, necessary habitat components would likely be retained, albeit at lower levels, to provide for fisher. The length of time these reductions would last depends upon the growth rate of the retention trees and resting/denning habitat development (snags and coarse woody debris). Therefore, seedtree, seedtree-with-reserves, and shelterwood units would result in decreased habitat availability for 10 to 20 years, while commercial-thin units and stream buffers would retain usable habitat, albeit of lesser quality, following harvesting. All action alternatives pose a moderate risk of preventing or reducing habitat use in the harvest units, which would result in habitat shifts away from these areas and increased use of other stands in the analysis area.

- ***Cumulative Effects Common to Action Alternative B, C, D, and E to Fishers***

Available fisher habitat would be reduced within the cumulative-effects analysis area. On DNRC-managed lands, available fisher habitat in the uplands would decline from 9,991 acres to between 8,712 and 8,806 acres (a 11.9- to 12.8-percent reduction in habitat). Additionally, habitat quality would be reduced on between 487 and 648 acres (4.9 to 6.5 percent of existing habitat).

No losses in the amount of fisher habitat associated with streams would occur, but 55 to 91 acres of habitat associated with riparian areas would be reduced in quality through timber harvesting. Additionally, connectivity would be maintained along the streams, ridges, and across third-order drainages (*ARM 36.11.441[1][c]*). On adjacent ownerships, an additional 6,452 acres of fisher habitat could be present, thereby, adding to the amount of fisher habitat in the analysis area. The reduction in fisher habitat is expected to result in avoidance of the seedtree harvest units, but, since the remaining portions of fisher habitat on DNRC-managed lands provide high densities of snags and coarse woody debris, the risk of these alternatives reducing the quantity or quality of fisher habitat to the point where fishers can no longer use the analysis area is low.

Other activities that could lead to additional impacts on fisher habitat include concurrent or future timber or salvage harvesting and public firewood cutting. DNRC is concurrently considering salvage harvests on an additional 120 acres in the analysis area. These harvests would not affect the quantity, but could reduce the quality of fisher habitat. No fisher habitat is expected to be harvested from adjacent lands during the 2007 through 2009 period. Firewood cutting would be limited to areas near open roads. Due to the small area affected by these additional activities, any additional changes in fisher habitat are expected to be minor.

Considered in conjunction with other past, present, and future activities, any proposed action alternative would likely result in a low risk of cumulative effects to fishers. *TABLE F-17 - PREDICTED POSTHARVEST FISHER HABITAT UNDER EACH ACTION ALTERNATIVE WITHIN THE CUMULATIVE-EFFECTS ANALYSIS AREA summarizes the effects to fisher habitat.*

*TABLE F-17 - PREDICTED POSTHARVEST FISHER HABITAT UNDER EACH ACTION ALTERNATIVE WITHIN THE CUMULATIVE-EFFECTS ANALYSIS AREA*

| FISHER HABITAT | | | ACRES OF RETAINED HABITAT (% REDUCTION) (% PREFERRED COVERTYPE*) | ACRES OF REDUCED QUALITY (% REDUCTION) (% PREFERRED COVERTYPE*) |
|---|---|---|---|---|
| Alternative | A | Upland habitat | 9,991 (0.0%) (77.2%) | 0 (0.0%) (0.0%) |
| | | Riparian habitat | 731 (0.0%) (86.9%) | 0 (0.0%) (0.0%) |
| | B | Upland habitat | 8,717 (12.8%) (67.4%) | 527 (5.3%) (4.1%) |
| | | Riparian habitat | 731 (0.0%) (86.9%) | 83 (11.4%) (9.9%) |
| | C | Upland habitat | 8,773 (12.2%) (67.8%) | 487 (4.9%) (4.1%) |
| | | Riparian habitat | 731 (0.0%) (86.9%) | 55 (7.5%) (6.5%) |
| | D | Upland habitat | 8,712 (12.8%) (67.3%) | 508 (5.1%) (4.1%) |
| | | Riparian habitat | 731 (0.0%) (86.9%) | 84 (11.5%) (10.0%) |
| | E | Upland habitat | 8,806 (11.9%) (68.0%) | 648 (6.5%) (4.1%) |
| | | Riparian habitat | 731 (0.0%) (86.9%) | 91 (12.5%) (10.8%) |

**Percent preferred covertype is the percentage of preferred covertype in the sawtimber size class with greater than 40-percent canopy cover divided by all acres of lands within these covertypes.*

- **Pileated Woodpecker**

***Issue***

Timber harvesting could cut nest trees or displace adults away from active nests, resulting in increased mortality of pileated woodpecker chicks.

***Dismissed***

Under all action alternatives, timber harvesting could result in direct mortality of nestlings if nest trees were cut prior to the nestlings' fledging or if the adults are displaced from the nest area. A majority of harvesting would occur after June 15 due to stipulations in the SVGBCA (ie., would occur outside the spring grizzly bear season) or would be delayed due to soil moisture conditions, and nest trees would likely be marked to leave. Therefore, most harvesting activities would occur after pileated woodpecker nestlings have fledged (*Bull and Jackson 1995*), and, if they occurred during the nesting period, the nest tree would likely be retained.

***Issue***

Timber harvesting would remove canopy cover and snags needed by pileated woodpeckers to forage and nest. The reduction of habitat could lead to a reduced ability

for pileated woodpeckers to use and/or reproduce in the area.

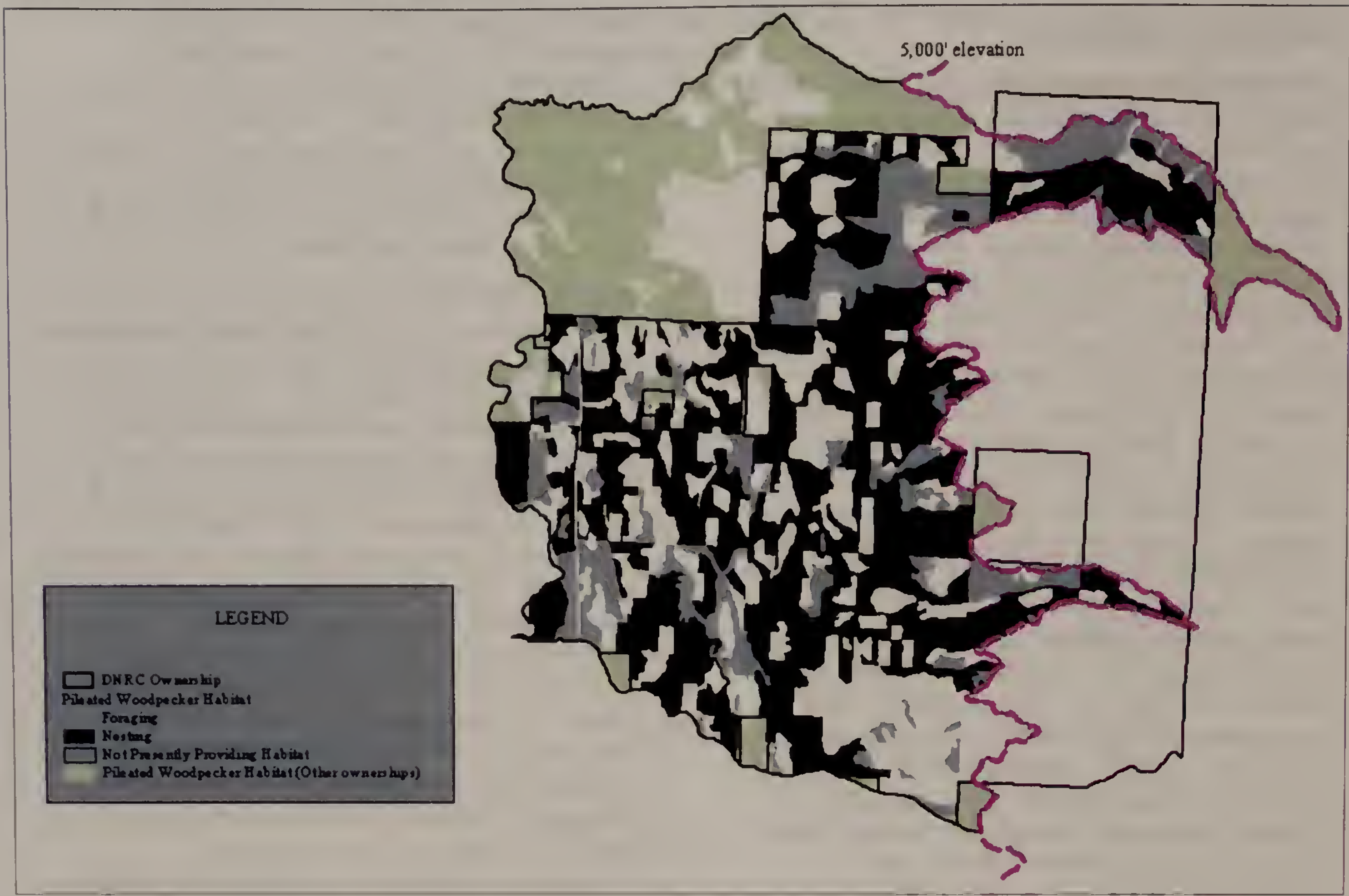
### *Existing Condition*

Pileated woodpeckers play an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals. Pileated woodpeckers excavate the largest cavities of any woodpecker. Preferred nest trees are western larch, ponderosa pine, cottonwood, and quaking aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated nesting habitat as..."stands of 50 to 100 contiguous acres, generally below 5,000 feet in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy." The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and downed wood for feeding, closely tie these woodpeckers to mature forests with late-successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*).

Pileated woodpecker habitat is comprised of nesting and foraging habitats. Pileated woodpecker nesting habitat was identified by searching the SLI database for stands over 100 years old and with more than 100 square feet basal area per acre, more than 40 percent canopy cover, and below 5,000 feet in elevation. Foraging habitat does not include the acres that meet the definition above, but includes the remaining sawtimber stands below 5,000 feet in elevation with greater than 40-percent canopy cover. To assess habitat on other ownerships in the cumulative-effects area, aerial photographs were interpreted to assess forest stands under 5,000 feet in elevation. Where stands appeared to meet the minimum potential foraging habitat, pileated woodpecker habitat was assumed present. Potential foraging and nesting habitat were not differentiated on other ownerships for this analysis due to data limitations.

The South Fork Lost Soup Grizzly Bear Subunit provided the analysis area to consider the effects to pileated woodpeckers. Since the project area occurs toward the upper elevations used by pileated woodpeckers and extends across 3 major drainages, the subunit analysis area was chosen to better reflect the potential pileated woodpecker home ranges that are contained within each drainage. A majority (73 percent) of this area is managed by DNRC, with adjacent lands also providing potential habitat. On DNRC-managed lands, 6,130 acres of nesting and 2,305 acres of foraging habitats currently exist. Although nesting habitat is defined differently than foraging habitat, nesting habitat also provides foraging opportunities for pileated woodpeckers. On adjacent ownerships, approximately 3,411 acres of habitat could occur. When combined, SLI modeling and the interpretation of aerial photographs for other than DNRC-managed lands indicated that approximately 11,846 acres of potential pileated woodpecker habitat are in the analysis area (*FIGURE F-9 - EXISTING DISTRIBUTION OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS*).

*FIGURE F-9 - EXISTING DISTRIBUTION OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LANDS AND POTENTIAL HABITAT ON ADJACENT LANDS*




### *Predicted Effects to Pileated Woodpeckers*

- ***Direct and Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  No disturbance of pileated woodpeckers would occur. Forest succession and natural disturbance agents would continue to bring about changes in existing stands. Trees would continue to grow, mature, and die, thus providing potential nesting and foraging structure for pileated woodpeckers. However, as shade-intolerant trees die and fall to the ground, barring any sizable disturbances that would promote the reestablishment of shade-intolerant tree species, preferred nesting trees (shade-intolerant) and snags could become rare. Thereby, nesting habitat structure would decline and could lead to decreased reproduction in the analysis area. Therefore, under this alternative, pileated woodpecker habitat would increase through time, then decline, resulting in a short- to mid-term moderate beneficial effect to pileated woodpeckers, but a long-term moderate negative effect due to the declining densities in quality nesting-habitat structure (western larch trees and snags).

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Pileated Woodpeckers***

  Under all action alternatives, between 1,051 and 1,559 acres of potential nesting, plus an additional 140 to 394 acres of potential foraging habitat, would be modified (*TABLE F-18 - CHANGES IN PILEATED WOODPECKER HABITAT UNDER EACH ACTION*

*TABLE F-18 - CHANGES IN PILEATED WOODPECKER HABITAT UNDER EACH ACTION ALTERNATIVE*

| PILEATED WOODPECKER HABITAT | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres of nesting habitat removed | 0 | 950 | 1,104 | 731 | 806 |
| Acres of nesting habitat altered | 0 | 448 | 455 | 320 | 344 |
| Acres of foraging habitat removed | 0 | 255 | 121 | 253 | 176 |
| Acres of foraging habitat altered | 0 | 48 | 19 | 104 | 218 |
| *Total acres of habitat affected* | *0* | *1,701* | *1,699* | *1,408* | *1,544* |

*ALTERNATIVE*). Where regeneration harvests are planned, potential pileated habitat (nesting and foraging) would be removed for 30 to 100 years, depending on the density of trees retained. In commercial thinning units, pileated woodpecker habitat would likely retain a minimum of 40-percent canopy cover, but the number of snags could be reduced substantially. However, 2 large snags per acre would be retained to approximate the average historic abundance of snags; therefore, adequate nesting and foraging structure would likely be retained, albeit reduced from current conditions. Since pileated woodpecker density is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*), pileated woodpecker densities in the analysis area could be expected to be reduced by all alternatives. In the longer term, seral species would be planted under this alternative and could provide pileated woodpecker habitat in the distant future (100 to 150 years).

**Cumulative Effects**

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

No projects are planned on adjacent ownerships; therefore, the amount of habitat on these lands is expected to be retained, while, over time, shade-intolerant tree species would become rare on adjacent lands. In combination with the effects expected under this alternative, nesting habitat structure could become rare on all lands in the analysis area, resulting in a moderate risk of reduced reproduction in the analysis area.

On DNRC-managed lands, salvage harvests are planned for 120 acres of nesting habitat in the analysis area. These salvage harvests remove dead and dying trees that could provide foraging and nesting structure and generally do not facilitate regeneration of shade-intolerant tree species for future habitat structure. Following harvesting, these acres would still qualify as nesting habitat because large snags and adequate canopy closure would be retained, albeit reduced. Thereby, these activities could result in both short-term and long-term reduction in habitat quality, but at a small scale, resulting in a low risk of additional effects to pileated use and reproduction in the analysis area.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Pileated Woodpeckers***

Potential habitat would be reduced to between 6,734 acres and 7,027 (a 16.7- to 20.1-percent reduction from the existing 8,435 acres) on DNRC-managed lands in the cumulative effects analysis area (*TABLE F-19 - ACREAGE OF PILEATED*

*TABLE F-19 - ACREAGE OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LAND AS A RESULT OF EACH ALTERNATIVE*

| PILEATED WOODPECKER HABITAT | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres of retained nesting habitat | 6,130 | 5,180 | 5,026 | 5,399 | 5,264 |
| (% reduction) | (0.0%) | (15.5%) | (18.0%) | (11.9%) | (14.2%) |
| Acres of reduced quality nesting habitat | 0 | 448 | 455 | 320 | 344 |
| (% reduction) | (0.0%) | (7.3%) | (7.4%) | (5.2%) | (5.6%) |
| Acres of retained foraging habitat | 2,305 | 2,050 | 2,148 | 2,052 | 2,129 |
| (% reduction) | (0.0%) | (11.1%) | (5.3%) | (11.0%) | (7.6%) |
| Acres of reduced quality foraging habitat | 0 | 48 | 19 | 104 | 218 |
| (% reduction) | (0.0%) | (2.1%) | (0.1%) | (4.5%) | (9.5%) |
| Total acres of pileated woodpecker habitat | 8,435 | 6,734 | 6,736 | 7,027 | 6,891 |
| (% reduction) | 0.0% | 20.2% | 20.1% | 16.7% | 18.3% |

*WOODPECKER HABITAT ON DNRC-MANAGED LAND AS A RESULT OF EACH ALTERNATIVE*). The proposed harvests would remove large patches of potential habitat, while retaining a majority of the existing habitat (between 79.9 and 83.3 percent) in the analysis area. Although potential habitat would be reduced under this alternative, the remaining habitat consists of high densities of snags that provide forage and nesting structure, which could offset some of the losses experienced in the harvest units. Additionally, estimated historic densities of large snags (2 snags per acre) would be retained within the harvest units to provide foraging and nesting structure when the canopy closure recovers to the point of allowing pileated woodpecker use. In addition, approximately 3,411 acres of potential pileated woodpecker habitat exists on the adjacent lands. In the long-term (100 to 150 years), these stands are expected to regenerate with a major proportion of western larch, which could provide nesting and feeding structural components in the future, thereby improving pileated woodpecker habitat. Each alternative is expected to remove between 11.9 and 18.0 percent of the existing nesting habitat, while reducing quality on an additional 5.2 to 7.3 percent of the available habitat. Foraging habitat would be less affected (*TABLE F-19 - ACREAGE OF PILEATED WOODPECKER HABITAT ON DNRC-MANAGED LAND AS A RESULT OF EACH ALTERNATIVE*). However, the reduction in nesting habitat would reduce nesting and foraging habitat structure available to pileated woodpeckers, which could result in a moderate risk of reducing the use and reproduction of pileated woodpeckers in the analysis area in the short term. These effects could be lessened to some degree due to the high density of snags found in the project area. In 80 to 100 years, each alternative would likely contribute to the potential for nesting structure in the analysis area by regenerating preferred nest trees (western larch).

Other activities in the area could reduce habitat quality, but no changes in quantity are

expected. DNRC is concurrently considering salvage harvests on an additional 120 acres of nesting habitat in the area. Following harvesting, these acres would still qualify as nesting habitat because large snags and adequate canopy closure would be retained. No other forest-management projects are expected to occur in the analysis area during the active period of 2007 through 2009. Firewood cutting would likely continue to remove dead and dying trees primarily along open roads on all lands in the South Fork Lost Soup Subunit. None of these activities would substantially add to the effects expected under each alternative. Considered in conjunction with other past, present, and future activities, any of the proposed action alternatives would result in low risk of cumulative effects to pileated woodpecker.

## BIG GAME

### *Issue*

Timber harvesting could reduce thermal cover on big game winter ranges. Reductions in thermal cover could result in a reduced carrying capacity of the winter range.

### *Existing Condition*

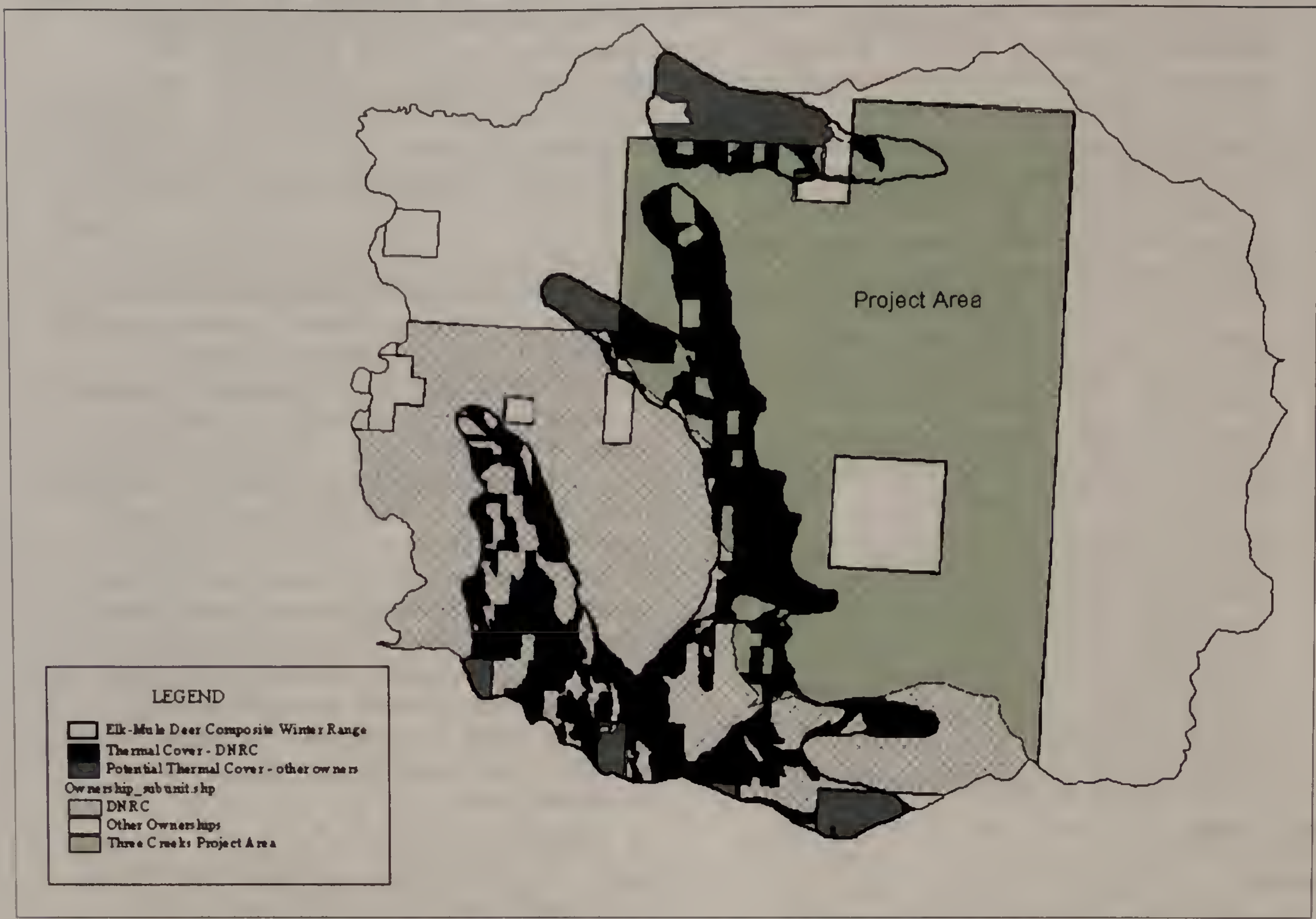
When considering populations of big game species, the winter-range component of their habitat is usually the limiting factor driving big game populations. During the winter period, plant dormancy results in decreased forage quality, while snow cover limits forage quantity and increases the energetic costs of maintaining body heat in a cold environment and movement through snow. To increase access to forage and decrease energetic costs, big game species seek areas with low snow cover and higher temperatures, which are typically found on south to west aspects. In addition, big game species seek vegetative cover to fulfill these same needs. Forest cover intercepts snow, which increases an animal's ability to find forage, while reducing the energetic costs of movement and ameliorating the effects of weather. Forested stands that fulfill these needs are referred to as thermal cover.

Thermal cover is defined for elk as stands with trees greater than 40 feet tall with a crown closure of 70 percent or more (*Thomas 1979*). Stands with 40- to 70-percent canopy closure may not provide thermal cover by definition, but do provide many of the benefits related to snow interception. Since western larch loses its needles during winter, stands dominated by western larch generally do not provide much snow intercept. Therefore, for this analysis, thermal cover includes pole and sawtimber stands with greater than 40-percent canopy closure that are not dominated by western larch.

To assess cumulative effects to big game, winter range within the South Fork Lost Soup Subunit was used. This scale of analysis provides enough area to provide winter habitat for a herd of elk. DFWP designated big game species throughout the State. In the analysis area, DFWP mapped elk (*DFWP 1999*) and mule deer (*DFWP 2004*) winter ranges, but no white-tailed deer (*DFWP 1996*) winter range. White-tailed deer winter range occurs primarily on the valley floor to the southwest of the analysis area in the Goat Creek Grizzly Bear Subunit. Changes to winter range caused by the proposed project could affect elk and mule deer winter range, but would not affect white-tailed deer. Therefore, the following analysis focuses on elk and mule deer, while not conducting any further analysis on white-tailed deer.

Since most of the winter range for elk and mule deer overlap, a composite winter range was used for

*FIGURE F-10 - THERMAL COVER LOCATED ON DNRC-MANAGED LANDS AND ADJACENT LANDS WITHIN THE ELK-MULE DEER COMPOSITE WINTER RANGE*




analysis purposes. The composite winter range includes 6,613 acres, of which 5,434 acres occur on DNRC-managed lands and 1,179 acres occur on other ownership in the analysis area (*FIGURE F-10 - THERMAL COVER LOCATED ON DNRC-MANAGED LANDS AND ADJACENT LANDS WITHIN THE ELK-MULE DEER COMPOSITE WINTER RANGE*). Of the winter range within the State ownership in the analysis area, 3,503 acres (64.5 percent) provide thermal cover. Based on interpretation of aerial photographs, approximately 1,100 acres (93.3 percent) on adjacent lands could provide thermal cover. When the winter range is analyzed for all ownerships in the analysis area, approximately 4,603 acres (69.6 percent) of thermal cover exists. However, this estimate is likely high due to the inclusion of stands dominated by western larch, which could not be distinguished through interpretation of aerial photographs.

### *PREDICTED EFFECTS TO ELK AND MULE DEER*

#### Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Elk and Mule Deer***

  Thermal-cover levels would not be affected. Through time, thermal cover could be reduced by insects and diseases. However, as overstory trees die, younger shade-tolerant trees present in the understory would likely fill in the canopy gap resulting in a short-term loss of thermal cover. Under this alternative, the ability of the available habitat to support the current elk and mule deer population would remain largely unchanged.

- ***Direct and Indirect Effects to Action Alternative B, C, D, and E to Elk and Mule Deer***

Each alternative proposes to harvest between 675 and 895 acres of thermal cover. However, only regeneration harvests (seedtree and shelterwood) would reduce canopy cover to less than 40 percent, resulting in a loss of thermal cover. Therefore, the alternatives would remove between 514 and 601 acres of thermal cover. On the other harvested acreage, greater than 40-percent canopy cover would be retained, which would retain thermal cover, albeit with reduced quality from the existing condition (*TABLE F-20 - ACRES OF THERMAL COVER AFFECTED BY ALTERNATIVE*). These reductions are expected to result in a moderate risk of habitat shifts of wintering elk and deer away from treated areas. The risk of avoidance would increase in relation to greater snow accumulations in these areas.

***TABLE F-20 - ACRES OF THERMAL COVER AFFECTED BY ALTERNATIVE***

| THERMAL COVER | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres removed | 0 | 542 | 600 | 514 | 601 |
| Acres reduced in quality | 0 | 149 | 109 | 161 | 294 |
| *Total acres of habitat affected* | *0* | *691* | *709* | *675* | *895* |

Cumulative Effects

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Elk and Mule Deer***

Following implementation of an action alternative, the amount of thermal cover on DNRC-managed portions of the composite winter range would range between 2,989 to 2,903 acres (a 14.7- to 17.2-percent reduction). Commercial-thin prescriptions would reduce the quality of thermal cover on another 3.1 to 8.4 percent of the existing thermal cover. The proposed harvests would reduce the percentage of winter range in thermal cover from 64.5 percent to between 53.4 and 55.0 percent on DNRC-managed lands (*TABLE F-21 - ACRES OF THERMAL COVER RESULTING FROM THE IMPLEMENTATION OF EACH ALTERNATIVE*). Concurrent salvage harvests on DNRC-managed lands (120 acres) within the winter range are not expected to alter thermal cover and, therefore, would not increase the risk of reducing carrying capacity on this portion of the winter range. On DNRC-managed lands, enough thermal cover would be retained under any alternative to provide adequate winter range habitat for elk and mule

***TABLE F-21 - ACRES OF THERMAL COVER RESULTING FROM THE IMPLEMENTATION OF EACH ALTERNATIVE***

| THERMAL COVER | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres of retained<br>(% reduction)<br>(% of winter range on DNRC) | 3,503<br>(0.0%)<br>(0.0%) | 2,961<br>(15.5%)<br>(54.5%) | 2,903<br>(17.1%)<br>(53.4%) | 2,989<br>(14.7%)<br>(55.0%) | 2,904<br>(17.2%)<br>(53.4%) |
| Acres of reduced quality<br>(% reduction)<br>(% of winter range on DNRC) | 0<br>(0.0%)<br>(64.5%) | 149<br>(4.3%)<br>(2.7%) | 109<br>(3.1%)<br>(2.0%) | 161<br>(4.6%)<br>(3.0%) | 294<br>(8.4%)<br>(5.4%) |
| Total acres affected<br>(% of winter range on DNRC)<br>(% affected) | 0<br>(0.0%)<br>(64.5%) | 691<br>(19.7%)<br>12.7%) | 709<br>(20.2%)<br>(13.0%) | 675<br>(19.3%)<br>(12.4%) | 895<br>(25.5%)<br>(16.5%) |

deer; therefore, a low risk to the reduction of carrying capacity is expected under any alternative.

In addition to the thermal cover found on DNRC-managed lands, an additional 1,100 acres of thermal cover could occur on adjacent ownerships within the cumulative-effects analysis area. When these acres are considered, the action alternatives would reduce the proportion of thermal cover on the composite winter range from 69.6 percent to between 60.5 and 61.8 percent. No additional forest-management activities are expected on adjacent lands during the 2007 through 2009 active period. Therefore, this thermal cover would remain available to winter animals, thereby reducing the overall effects of any alternative. However, the use of harvested areas is expected to be reduced when snow accumulations increase. Considered in conjunction with other past, present, and future activities, any of the proposed action alternatives would result in low risk of substantially reducing the carrying capacity of elk and mule deer in the analysis area.

*Appendix G*

*Soils Analysis*

# APPENDIX G
# SOILS ANALYSIS

## INTRODUCTION

The Swan River watershed is a valley formed by glaciers and river processes. The dominant soil types found in the project area are deep glacial tills derived from argillite, siltite, and limestone from the Belt Supergroup. Upper slopes and ridges are weathered bedrock scoured by glaciers. This analysis addresses the issue that timber harvesting and associated activities may affect soil conditions in the proposed project area.

## ANALYSIS METHODS

Soil effects and conditions will be analyzed by evaluating the current levels of soil disturbance in the proposed project area through the use of aerial-photo interpretation and ocular estimates based on field review of existing and proposed harvest units. Analysis will also include assessing slope stability with aerial-photo interpretation and field review of proposed roads and harvest units.

Estimated effects of proposed activities will be assessed based on findings of DNRC soil monitoring. Soil-monitoring efforts have been ongoing by DNRC over the last 20 years. Through soil monitoring conducted in Swan River State Forest on soil types similar to those found in the proposed project area, DNRC found that ground-based skidding on slopes of 0 to 15 percent on the Goat Creek watershed resulted in 13.8 percent of the area in detrimental soil effects, with no observed soil erosion. Ground-based skidding on slopes of 20 to 50 percent in the Woodward Creek watershed in 2002 resulted in 8.1 percent of the area in detrimental soil effects, and spotty soil erosion was observed on segments of skid trails (*DNRC 2004*). Based on analysis in the SFLMP, analysis found that up to 20 percent of ground-based harvest areas would be trafficked by skid trails (*DNRC 1996*), and DNRC soils monitoring has shown that up to an estimated 75 percent of the skid trails would result in moderate to severe impacts. In addition, DNRC conducted soil monitoring in 2002 on cable-yarding units in a burned area. The results of this monitoring are found in the *MOOSE PROJECT SOIL MONITORING REPORT (DNRC 2003)*. Results found that up to 5 percent of cable yarding units were in an impacted condition.

## ANALYSIS AREA

The analysis area for evaluating soil effects will include State-owned land within the Three Creeks Timber Sale Project area. The proposed project area is found within the South Fork Lost Creek, Cilly Creek, and Soup Creek watersheds.

## EXISTING CONDITIONS

Soil types in the project area include deep alluvial and glacial deposits on the nearly level valley floor with wetland types in the lower portions of Cilly Creek and Soup Creek. The valley sideslopes have moderate to deep glacial till deposits with cobbly silt loam subsoils and, in most cases, a volcanic ash surface soil. Shallow bedrock and high-rock-content residual soils are found on glacial scoured ridges. A list of soil types found in the Three Creeks Timber Sale Project area and their

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associated management implications is found in *TABLE G-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE THREE CREEKS PROJECT AREA.* The *FNF Soil Survey* identified one area of soils at elevated risk for mass movements in the project area. This soil type is landtype 77, and is found in the southern portion of the proposed project area south of Soup Creek. During field reconnaissance, several areas of past slope instability were identified in the proposed project area. These areas, mostly small, are a result of several site-specific conditions. These conditions include a combination of the glacial till, steep slopes, shallow depth to bedrock, and avalanche chutes; in one case, past management may have been a contributing factor. A more detailed description of past slope instability and recommended measures to mitigate for possible instability can be found in the project file at Swan River State Forest.

The proposed project area is approximately 10,344 acres and is located in Swan River State Forest. In the proposed project area, DNRC has conducted timber harvesting since the 1950s. Based on review of aerial photos from the 1960s through the present, section record cards, and timber sale records, approximately 1,463 acres (or about 14 percent of the acres in the project area) have been harvested on State land within the proposed project area using a combination of ground-based and cable-yarding harvest methods. Ground-based yarding can affect soil conditions through displacement and compaction of productive surface layers of soil, mainly on heavily used trails. Cable yarding can also produce impacts to soils. These impacts mainly occur where one end of the logs are dragged on the ground as logs are lifted to the landing, especially on convex slopes where the cable line may be closer to the ground and logs are not lifted as high. These impacts are generally far less in area and degree of impact than impacts from ground-based skidding.

Based on field review of past harvest areas within the proposed project area, existing soils impacts are estimated to be 10 percent or less of the previously harvested areas. Field reconnaissance using ocular estimates shows that existing skid trails are adequately spaced, many of the existing trails from past management are well vegetated, and past impacts are ameliorating from frost and vegetation growth. Minimal evidence of isolated soils erosion was observed on short pitches of existing skid trails and landings within the project area.

## ALTERNATIVE EFFECTS

### *DIRECT AND INDIRECT EFFECTS*

- ***Direct and Indirect Effects of No-Action Alternative A to Soils***

  Direct or indirect impacts would not occur with this alternative. No ground- or cable-based activity would take place under this alternative, which would leave the soil in the project area unchanged from the description in *EXISTING CONDITIONS* of this analysis. Existing areas of slope instability or erosion would continue to recover or degrade according to natural and preexisting conditions and would not be affected by this alternative.

- ***Direct and Indirect Effects Common to Action Alternatives B, C, D, and E to Soils***

  The estimated range of soil impacts for all action alternatives is from 7 to 9 percent, and no individual harvest unit is expected to have impacts greater than 15 percent. Fifteen percent impacts fall within the range of impacts analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP (DNRC 1996)*. According to the SFLMP, the level of concern for compaction and

displacement is elevated when these impacts exceed 20 percent of an area (*DNRC 1996*). DNRC expects that by maintaining 85 percent of the area with healthy soil conditions and limiting the detrimental effects of moderate and severe displacement, compaction, and erosion to less than 15 percent of the area, productive and hydrologically stable sites will be maintained within harvested areas. This level of impacts would be achieved through a combination of skidding mitigation measures including, but not limited to:

- slope and equipment restrictions;
- restriction for season-of-use to periods of dry, frozen, or snow-covered soil conditions;
- utilization of a minimum skid-trail spacing;
- installation of erosion control where needed;
- retention of 10 to 15 tons per acre of woody debris; and
- adherence to all applicable BMPs.

An assessment of the impacts of the proposed action alternatives on slope stability can be found in the project file at the Swan River State Forest office.

Timber-harvesting operations in all action alternatives would retain adequate coarse woody debris (greater than 3 inches in diameter) and green litter to conserve available nutrients and maintain long-term soil conditions similar to the range of natural conditions. To be effective, the material would be well distributed across the management unit. Current direction for recommended amounts of debris to retain during operations would be based on *"Managing Coarse Woody Debris in Forests of the Rocky Mountains" (Graham et al. 1994)* and ranges from 4 to 33 tons per acre based on habitat types. As more information on the role of woody debris and litter is developed concerning tree growth and site productivity, DNRC may modify the recommendations. On sites where levels of coarse woody debris are below average historic levels (compared to *Graham et al 1994*), proposed silvicultural prescriptions would be designed to promote larger tree diameters for future coarse woody debris through snag management (*ARM 36.11.411*).

- ***Direct and Indirect effects of Action Alternative B to Soils***

BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 8.7 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed in the *ANALYSIS METHODS* portion of this analysis. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 891 acres, cable yarding on approximately 557 acres, and landings from helicopter yarding.

Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 - SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative B. These activities would leave up to 8.7 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in

the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

- ***Direct and Indirect Effects of Action Alternative C to Soils***

BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 8.6 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed under *ANALYSIS METHODS*. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 823 acres, cable yarding on approximately 543 acres, and landings from helicopter yarding.

Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 - SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative C. These activities would leave up to 8.6 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

- ***Direct and Indirect Effects of Action Alternative D to Soils***

BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would have direct impacts on an estimated 7.2 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed under *ANALYSIS METHODS*. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 699 acres, cable yarding on approximately 679 acres, and landings from helicopter yarding.

Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 - SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative D. These activities would leave up to 7.2 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

- ***Direct and Indirect Effects of Action Alternative E to Soils***

BMPs and a combination of mitigation measures would be implemented to limit the area and degree of soil impacts as noted in *ARM 36.11.422* and the *SFLMP (DNRC 1996)*. This alternative would

have direct impacts on an estimated 7.6 percent of the area in proposed harvest units. This includes skid trails, landings, cable-yarding corridors, and impacted spots. The estimate is based on procedures detailed in the *ANALYSIS METHODS* portion of this analysis. Direct impacts to soils would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 786 acres, cable yarding on approximately 629 acres, and landings from helicopter yarding.

Ground-based site preparation and road construction would also generate direct impacts to the soil resource. Site-preparation disturbance would be intentionally done, and these impacts are considered light and promote reforestation of the site. *TABLE G-1 - SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative E. These activities would leave up to 7.6 percent of the proposed harvest units in an impacted condition. This level is below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and are well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

*CUMULATIVE EFFECTS*

- ***Cumulative Effects of No-Action Alternative A to Soils***

This alternative would have no additional cumulative impacts on soil conditions. No soil would be disturbed, and no past harvest units would be entered. Previously harvested areas would continue to ameliorate over time. Cumulative effects of this alternative would be similar to those described under *EXISTING CONDITIONS* of this analysis.

- ***Cumulative Effects to Soils Common to Action Alternatives B and C***

Both of these alternatives would enter one stand (approximately 19 acres) where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand. Cumulative impacts may include compaction, displacement, and erosion on additional trails beyond those already existing from past entries. Additional compaction and displacement may occur on existing trails from reuse. Any amelioration of compaction from frost action and vegetation is erased if an existing trail is

***TABLE G-1 - SUMMARY OF DIRECT EFFECTS OF ALL ALTERNATIVES ON SOILS WITH SUMMER HARVESTING***

| DESCRIPTION OF PARAMETER | ALTERNATIVE | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Acres of harvest | 0 | 1,856 | 1,752 | 1,941 | 1,966 |
| Acres of helicopter yarding | 0 | 408 | 386 | 563 | 551 |
| Acres of tractor yarding | 0 | 891 | 823 | 699 | 786 |
| Acres of skid trails and landings[1] | 0 | 178 | 165 | 140 | 157 |
| Acres of cable yarding | 0 | 557 | 543 | 679 | 629 |
| Acres of yarding corridors[2] | 0 | 56 | 54 | 68 | 63 |
| Acres of moderate impacts[3] | 0 | 162 | 151 | 139 | 149 |
| Percent of harvest area with impacts | 0% | 8.7% | 8.6% | 7.2% | 7.6% |

[1] *20 percent of ground-based area*
[2] *5 to 10 percent of cable yarding units*
[3] *75 percent of ground-based skid trails and 50 percent of cable corridors (based on DNRC monitoring as reported under ANALYSIS METHODS)*

reused by equipment, and the effects may be more extensive with repeated use. DNRC would maintain healthy soil conditions and minimize adverse cumulative effects by implementing any or all of the following:

- use of existing skid trails from past harvesting activities if they are properly located and spaced;
- use of additional skid trails only where existing trails are unacceptable;
- use of soil moisture restrictions, season of operation, and method of harvesting to mitigate potential direct and indirect effects; and
- retention of 10 to 15 tons per acre of coarse woody debris and fine litter for nutrient cycling.

Based on soil monitoring conducted on DNRC land in Swan River State Forest, DNRC expects cumulative effects to soil conditions to be 15 percent or less of harvested areas, including impacts from past harvesting. In most of the proposed project area, cumulative impacts would be less than 10 percent. Each value is within or below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

In the remaining previously unharvested stands, cumulative effects to soil conditions from multiple entries would be the same as those listed under *Direct and Indirect Effects*. For slash treatment, equipment piling of slash and site preparation would be limited to less than 30-percent scarified soils within regeneration harvest units. Scarification to mix the surface duff to promote conifer establishment, but not remove surface soil, is considered a nondetrimental effect to soils. Future stand entries would likely use existing trails and landings.

- ***Cumulative Effects of Action Alternative D to Soils***

This alternative would enter one stand (approximately 8 acres) where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand. Cumulative impacts may include compaction, displacement, and erosion on additional trails beyond those already existing from past entries. Additional compaction and displacement may occur on existing trails from reuse. Any amelioration of compaction from frost action and vegetation growth is erased if an existing trail is reused by equipment, and the effects may be more extensive with repeated use. DNRC would maintain healthy soil conditions and minimize adverse cumulative effects by implementing any or all of the following:

- use of existing skid trails from past harvesting activities if they are properly located and spaced;
- use of additional skid trails only where existing trails are unacceptable;
- use of soil moisture restrictions, season of operation, and method of harvesting to mitigate potential direct and indirect effects; and
- the retention of 10 to 15 tons per acre of coarse woody debris and fine litter for nutrient cycling.

Based on soil monitoring conducted on DNRC-managed land in Swan River State Forest, DNRC expects cumulative effects to soil conditions to be 15 percent or less of harvested areas, including impacts from past harvesting. In most of the proposed project area, cumulative impacts would be less

than 10 percent. Each value is within or below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP* and well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

In the remaining previously unharvested stands, cumulative effects to soil conditions from multiple entries would be the same as those listed under *DIRECT AND INDIRECT EFFECTS*. For slash treatment, equipment piling of slash and site preparation would be limited to less than 30-percent scarified soils within regeneration harvest units. Scarification to mix the surface duff to promote conifer establishment, but not remove surface soil, is considered a nondetrimental effect to soils. Future stand entries would likely use existing trails and landings.

- ***Cumulative Effects of Action Alternative E to Soils***

This alternative would enter 2 stands (combined 27 acres) where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand. Cumulative impacts may include compaction, displacement, and erosion on additional trails beyond those already existing from past entries. Additional compaction and displacement may occur on existing trails from reuse. Any amelioration of compaction from frost action and vegetation growth is erased if an existing trail is reused by equipment, and the effects may be more extensive with repeated use. DNRC would maintain healthy soil conditions and minimize adverse cumulative effects by implementing any or all of the following:

- use of existing skid trails from past harvesting activities if they are properly located and spaced;
- use of additional skid trails only where existing trails are unacceptable;
- use of soil moisture restrictions, season of operation, and method of harvesting to mitigate potential direct and indirect effects; and
- the retention of 10 to 15 tons per acre of coarse woody debris and fine litter for nutrient cycling.

Based on soil monitoring conducted on DNRC-managed land in Swan River State Forest, DNRC expects cumulative effects to soil conditions to be 15 percent or less of harvested areas, including impacts from past harvesting. In most of the proposed project area, cumulative impacts would be less than 10 percent. Each value is within or below the range analyzed for in the *EXPECTED FUTURE CONDITIONS* section of the *SFLMP*, and well within the 20-percent impacted area established as a level of concern in the *SFLMP (DNRC 1996)*.

In the remaining previously unharvested stands, cumulative effects to soil conditions from multiple entries would be the same as those listed under *DIRECT AND INDIRECT EFFECTS*. For slash treatment, equipment piling of slash and site preparation would be limited to less than 30-percent scarified soils within regeneration harvest units. Scarification to mix the surface duff to promote conifer establishment, but not remove surface soil, is considered a nondetrimental effect to soils. Future stand entries would likely use existing trails and landings.

*TABLE G-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE THREE CREEKS PROJECT AREA*

| MAP UNIT | DESCRIPTION | SOIL DRAINAGE | ROAD LIMITATIONS | TOPSOIL DISPLACEMENT AND COMPACTION | SEEDLING ESTABLISHMENT | EROSION (BARE SURFACE) | NOTES |
|---|---|---|---|---|---|---|---|
| 16 | Alluvial fans | Well drained | Low to moderate | Moderate | Fair | Slight | Deep gravel and shallow surface soils. Bear grass competition common. Avoid displacement. |
| 21-8 | Cirque basins, 20-40% | Somewhat excessive | Moderate - rock on ridges | Moderate | Fair, droughty | Moderate | Moderate. Deep coarse soils reduce water and nutrients. South slopes droughty. On slopes over 35 percent, lop and scatter, excavator pile, or broadcast burn slash. |
| 21-9 | Rock out-crops, shallow glacial till, 40-60% | Moderate to well | Low/moderate | Moderate | Poor | Moderate | Unsurfaced roads are very bumpy due to shal-low bedrock. |
| 26A-7 | Deep glacial till, 0-20% | Well drained | Low | Moderate (severe if wet) | Good | Low | Deep, productive soil is well suited to tractor operation. Limited dry season of use. |
| 26A-8 | Glacial till, 20-40% | Well drained | Moderate | Moderate | Good | Moderate | Deep, productive soil. Fine textured soil remains moist; check soil moisture. Topsoil depth important. |
| 26A-9 | Glacial till, 40-60% | Well drained | Moderate | Moderate | Good | Moderate | Deep, productive soil. Fine-textured soil remains moist, check soil moisture. Topsoil depth important. |
| 26C-7 | Glacial moraines, 0-20% | Well drained | Low | Moderate (severe if wet) | Good | Low | Deep, productive soil. Topsoil depth important. |
| 26C-9 | Glacial moraines, 40-60% | Well drained | Moderate/high | Moderate/high | Good | Moderate/ high | Deep, productive soil, average season of use. Limit soft-track skidder to slopes less than 45 percent. |
| 26D-7 | Glacial moraines, 0-20% | Well drained | Moderate | Moderate | Good | Moderate | Deep, productive soil. Topsoil depth important. |
| 57-9 | Residual soils and moderate deep glacial till 20-40% | Well drained | Moderate | Severe displacement | Fair-good; dry on south slopes | Moderate | Steep slopes limit tractor operation. Use cable or helicopter yarding system. |
| 72 | Glacial cirque wall, 60-90% | Well drained | Rocky, steep | Low | Very poor | Low | Very shallow soils with excessively steep sideslopes. Cutslopes are difficult to revegetate. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 73 | Glacial trough wall, 60-90% | Well drained | Rocky, steep | Cable - moderate | Fair | High | Steep slopes, rocky soils with common rock out-crops. Cable logging recommended for slopes over 45 percent. Lop and scatter or excavator-pile slash. |
| 75 | Rock, residual soils on steep slopes | Somewhat excessive | Rock | Displacement - high | Fair, droughty | Moderate | Shallow and moderately deep, very gravelly/ rocky soils. Cable yarding on slopes over 45 percent, broadcast burn. |
| 76 | Geologic breaklands, slopes over 60% | Excessive | Severe; rock outcrops | High displacement | Good | High | Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45 percent. Lop and scatter or excavator-pile slash. |
| 77 | Geologic breaklands, slopes over 60% | Excessive | Severe; rock outcrops, steep | High displacement | Poor, subalpine climate | High | Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45 percent. Lop and scatter or excavator-pile slash. |
| 78 | Glacial trough wall, 60-90% | Well drained | Rocky, steep | High displacement | Fair, droughty | Moderate | Steep slopes, rocky soils with common rock out-crops. Cable logging recommended for slopes over 45 percent. |

FIGURE G-1 - THREEE CREEKS TIMBER SALE PROJECT LANDTYPE MAP

Appendix H
Economic
Analysis

# APPENDIX H
# ECONOMICS ANALYSIS

## INTRODUCTION

This section analyzes the economic impacts associated with each of the alternatives and how they affect revenue to the trust, local employment and income, and other uses of the area. The Three Creeks Timber Sale Project is located in Swan River State Forest, located in the southeastern corner of Lake County and near the northeastern corner of Missoula County. The sale is in an area of relatively low population density and has produced timber for the area mills since the 1800s. The focus of this section will be on market activities that directly or indirectly benefit the Montana education system, generate revenue for the school trust fund, and provide funding for public buildings.

## EXISTING CONDITIONS

The location of Swan River State Forest in relation to the lumber and plywood mills and pulp producers likely to be interested in the timber sale necessitates analyzing economic and demographic data from several counties. Producers from Lake, Missoula, and Flathead counties are all likely to have an interest in this sale. *TABLE H-1 – SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES* contains selected demographic information for each of these counties and the entire State.

*TABLE H-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD, LAKE, AND MISSOULA COUNTIES*

| DEMOGRAPHIC | COUNTY | | | STATE OF MONTANA |
|---|---|---|---|---|
| | FLATHEAD | LAKE | MISSOULA | |
| Population 1990 | 59,218 | 21,041 | 78,687 | 799,065 |
| Population 2000 | 74,471 | 26,507 | 95,802 | 902,195 |
| Growth rate (%) | 2.3 | 2.3 | 2.0 | 1.2 |
| Median age | 37.2 | 38.2 | 33.2 | 37.8 |
| School enrollment | 13,000 | 4,560 | 9,400 | 157,560 |
| *Source: Montana Department of Labor and Commerce and the Office of Public Instruction* | | | | |

Flathead and Lake Counties are widely known for their production of "Flathead cherries" and Christmas tree farms. Flathead County includes the northern portion of Flathead Lake and the west side of Glacier Park. Lake County encompasses a large part of Flathead Lake and includes much of the Flathead Indian Reservation. Missoula County includes the University of Montana as well as several timber-processing facilities. Kindergarten through 12 school enrollment in the 3 counties totals nearly 27,000. Flathead County is the second largest county in terms of population, but boasts the largest school population, 13,000, which is almost half of the total kindergarten through 12 school population for the 3 counties.

The data in *TABLE H-2 - COVERED WAGES AND EMPLOYMENT IN 1999 FOR SELECTED INDUSTRIES IN FLATHEAD, LAKE, AND MISSOULA COUNTIES* shows employment and income in selected

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*TABLE H-2 - COVERED WAGES AND EMPLOYMENT IN 1999 FOR SELECTED INDUSTRIES IN FLATHEAD, LAKE, AND MISSOULA COUNTIES*

| INDUSTRY | FLATHEAD COUNTY | | | LAKE COUNTY | | | MISSOULA COUNTY | | |
|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE ANNUAL EMPLOYMENT | ANNUAL WAGE (000) | AVERAGE WAGE | AVERAGE ANNUAL EMPLOYMENT | ANNUAL WAGE (000) | AVERAGE WAGE | AVERAGE ANNUAL EMPLOYMENT | ANNUAL WAGE (000) | AVERAGE WAGE |
| Agriculture, forestry, and fishing | 382 | $14,627 | $38,291 | 84 | $1,721 | $20,488 | 408 | $13,019 | $31,936 |
| Forestry | 250 | 10,045 | 40,180 | 38 | 1,064 | 28,757 | 249 | 8,019 | 32,164 |
| Construction | 3,090 | 97,117 | 31,429 | 444 | 10,990 | 24,752 | 3,064 | 96,896 | 31,622 |
| Manufacturing | 3,086 | 119,018 | 38,056 | 756 | 22,750 | 30,093 | 2,831 | 109,047 | 38,514 |
| Wood products | 1,517 | 64,136 | 42,278 | 199 | 6,690 | 33,618 | 923 | 33,536 | 36,318 |
| Metals | 330 | 13,241 | 40,124 | NA | NA | NA | 58 | 1,896 | 32,450 |
| Transportation | 684 | 19,569 | 28,610 | 36 | 646 | 17,944 | 1,751 | 55,322 | 31,600 |
| Trade | 6,401 | 148,736 | 23,236 | 1,248 | 25,995 | 20,245 | 10,026 | 205,965 | 20,543 |
| Eating and drinking establishments | 1,036 | 20,269 | 19,565 | 685 | 6,682 | 9,755 | 903 | 16,460 | 18,220 |
| Financial, insurance, and real estate | 2,173 | 76,451 | 35,182 | 304 | 8,303 | 27,313 | 2,353 | 78,382 | 33,312 |
| Services | 14,390 | 310,457 | 21,574 | 2,428 | 47,693 | 19,642 | 21,992 | 538,233 | 24,474 |
| Hotels, etc. | 1,235 | 20,341 | 16,470 | 186 | 1,704 | 9,161 | 1,045 | 13,068 | 12,506 |
| Amusement and recreation | 949 | 12,769 | 13,455 | 72 | 996 | 13,833 | 1,067 | 12,869 | 12,066 |
| Government | 4,482 | 149,636 | 33,386 | 2,585 | 76,360 | 29,540 | 8,452 | 306,456 | 36,260 |
| Total all industries | 35,707 | $974,651 | $27,296 | 8,283 | $209,533 | $25,297 | 42,212 | $1,492,033 | $28,576 |

Source: *Montana Department of Labor and Industry, Research and Analysis Bureau*

industry categories for each of the 3 counties included in the analysis. Economic activity within these counties varies substantially, although all 3 counties have some timber-related industries.

Flathead County has a larger number of workers employed in timber-related jobs than does Missoula County. Lake County has the smallest labor force and the smallest number of workers employed in timber-related jobs. In all 3 counties, timber-related jobs pay more than the average wage in Missoula County; the average wage in the timber industry is 49 percent higher than the average wage for all industries.

The corresponding wage comparison numbers for Lake and Flathead counties are 50 percent and 39 percent, respectively. Service-industry wages are lower than the average in all 3 counties. The largest difference is in Missoula County, where wages in hotels and the recreation and amusement industries are 60 percent of the countywide average. The service industries provide employment for 2 to 3 times as many workers as the timber industry, but at a substantially lower wage.

**ALTERNATIVE EFFECTS**

***DIRECT EFFECTS***

Five options are being analyzed in this EIS. The following estimates are intended for relative comparison of alternatives and are not intended to be absolute estimates of returns, taxes, employment, or wages.

- ***Direct Economic Effects of No-Action Alternative A***

  If No-Action Alternative A were followed, none of the employment, income, or trust fund effects that result from the action alternatives would occur.

- ***Direct Economic Effects of Action Alternatives B, C, D, and E***

  - **Timber Sale Effects**

    The estimated revenue and expenditures associated with the Three Creeks Timber Sale Project are shown in *TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*. Because there are no impacts from timber harvesting associated with No-Action Alternative A, the remaining analysis will focus on the other 4 alternatives. The estimated revenues and expenditures associated with the Three Creeks Timber Sale Project are shown in *TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*. The 4 alternatives analyzed may ultimately be broken into smaller sales, but are treated as a unit for the purpose of this analysis. The volume associated with each of the alternatives is shown in *TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*. The area associated with each alternative is identified in *CHAPTER II - ALTERNATIVES*. Revenue per acre is highest for Action Alternative C, followed in order by Action Alternatives B, D, and E. Revenue estimates for this sale are somewhat lower than would normally be expected; however, each alternative has a significant component of helicopter logging. Helicopter logging is comparatively expensive and bid estimates were reduced to reflect the higher logging costs.

    Stumpage prices, which are currently flat and near the long-term average, are highly dependent on the housing market, which in turn is dependent, among other things, on the

*TABLE H-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE THREE CREEKS TIMBER SALE PROJECT*

| | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|
| | B | C | D | E |
| Harvest volume (tons) | 154,557 | 147,771 | 167,687 | 155,838 |
| Stumpage price $/ ton | 34.41 | 34.43 | 32.73 | 33.26 |
| FI fee (total $) | 463,700 | 443,300 | 503,100 | 467,500 |
| Stumpage revenue (total $) | 5,318,300 | 5,087,800 | 5,488,400 | 5,183,200 |
| Trust income ($) | 3,459,900 | 3,309,800 | 3,505,300 | 3,301,400 |
| State income ($) | 5,782,000 | 5,531,100 | 5,991,500 | 5,650,700 |
| Expenditures ($) | 2,322,000 | 2,221,300 | 2,486,200 | 2,349,308 |
| Trust income per acre ($) | 1,864 | 1,889 | 1,806 | 1,679 |

*Source: DNRC, Trust Land Management Division*
*Note: Totals may not add due to rounding.*

interest rate. The interest rate, in part, determines who can "qualify" to purchase a home. Interest rates are currently at very low levels that have not been seen since the late 1950s and early 1960s. These low interest rates would normally impact the housing market by stimulating new construction to satisfy the demand for housing from individuals who can now "qualify" to purchase a home. The economy is in a period of steady growth. Large federal budget expenditures have had a positive impact on the current U.S. economy. The housing market has generally been very strong and has only recently demonstrated any signs of weakening. As a result, housing starts, while generally increasing, are showing some weakening and have in recent months been lower than last year's level. In addition, mortgage interest rates appear to be increasing, which will offset some of the income gains in the other sectors of the economy. These factors have resulted in timber prices at or near historical averages. The timber prices used in this analysis attempt to recognize the current market conditions.

*TABLE H-4 - NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE* shows the differences in revenue to the trusts from the 4 action alternatives.

The school trust income from Action Alternative B is

***TABLE H-4 - NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE***

| | ACTION ALTERNATIVE | | | |
|---|---|---|---|---|
| | B | C | D | E |
| Estimated school revenue | $3,459,900 | 3,309,800 | 3,505,300 | 3,301,400 |
| Students funded | 489 | 467 | 495 | 466 |

*Source: Montana DNRC, Trust Land Management Division*

estimated to be $3,459,900, enough to fund the education of 489 students for 1 year based on an average cost of $7,080, as determined from information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 - NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE.* If the sale does not take place, no students are benefited. Thus, one of the "costs" of not harvesting the timber compared to harvesting under Action Alternative B is the loss of financing for 489 kindergarten through grade 12 students for a year. If the trust does not fund these students through the sale of timber, funding must come from other sources, primarily property taxes.

The school trust income from Action Alternative C is estimated to be $3,309,800, enough to fund the education of 467 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. Action Alternative C earns the highest amount of trust income per acre, has the lowest expenditure level of any alternative, the lowest number of road miles, and harvests on the fewest number of acres. This information is shown in *TABLE H-4 - NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE.* If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action Alternative C is the loss of financing for 467 kindergarten through grade 12 students for a year.

The school trust income from Action Alternative D is estimated to be $3,505,300, enough to fund the education of 495 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 - NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE.* If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action Alternative D is the loss of financing for 495 kindergarten through grade 12 students for a year.

The school trust income from Action Alternative E is estimated to be $3,301,400, enough to fund the education of 466 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE H-4 - NUMBER OF STUDENTS FUNDED FOR ONE YEAR FROM THE ESTIMATED REVENUE.* If the sale does not take place, no students are benefited. A "cost" of not harvesting compared to harvesting the timber under Action Alternative E is the loss of financing for 466 kindergarten through grade 12 students for a year.

- **Timber-Related Employment**

Timber harvesting generates employment. *Keegan et al* estimate that, on average, 10.58 jobs are created for every mmbf of timber harvested. Both economic theory and empirical analysis suggest that the marginal effect of an increase in the timber harvested is likely to be different than the average effect because of increasing returns.

The marginal effect may be larger or smaller than the average. Empirical evidence



*Keegan, Charles et al, 1995, Montana's Forest Products Industry, A Descriptive Analysis, 1969-1994*

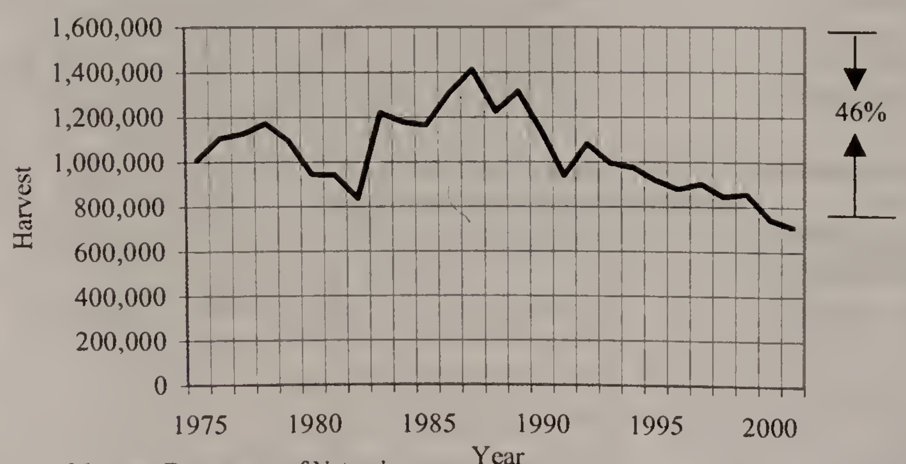
would suggest that in a growing industry, marginal effect on employment is likely to be smaller than the average. In a contracting industry, the marginal effect on employment could be either larger or smaller than the average. In most cases the marginal effect of increased or decreased timber sales is "lumpy", i.e. 2 sales of the same size under different conditions might induce a larger than average employment response in one case and a smaller than average employment response or nearly negligible employment response in another.

*FIGURE H-1- TOTAL TIMBER HARVEST FROM MONTANA FORESTS (MBF)* demonstrates that the amount of timber being harvested in Montana has declined since 1987. The decrease in the harvest since the peak of 1,411 mmbf in 1987 has been nearly 46 percent, to 710 mmbf in 2001. Mills, such as the American Timber Company mill in Olney, have closed, citing a lack of available timber as the cause of their foreclosure (*Missoulian, 1/12/2000*). All of these point to an industry declining in size. Based on the previous discussion, the assumption of the average induced employment of 10.58 jobs per mmbf is reasonable. Because the exact conditions of this sale are unknown, the best estimate of employment, i.e. the average effect on employment, should be used since it is the best estimate available, and the marginal effect of the sale is unknown.

A ratio of 10.58 jobs per mmbf of wood harvested implies the direct generation of between 241 and 273 jobs and between $9.3 and $10.6 million in wages, depending on which alternative is chosen. The wages are based on an average wage of $38,874, derived from data in *TABLE H-2 - COVERED WAGES AND EMPLOYMENT IN 1999 FOR SELECTED INDUSTRIES IN FLATHEAD, LAKE, AND MISSOULA COUNTIES*. The estimated wages shown in *TABLE H-5 - THREE CREEKS TIMBER SALE PROJECT DIRECT EMPLOYMENT TO INCOME IMPACTS* are the result of employment within the timber industry. Without a timber harvest, income will be lost to the State and communities. Wages in the timber industry are higher than average. This allows individuals working in the industry to obtain higher than average ownership of real personal property. Since much of the revenue for school funding comes from property taxation, higher levels of real property ownership should provide for better school funding.

In addition to these jobs, additional employment is created when the income earned within

***FIGURE H-1 - TOTAL TIMBER HARVEST FROM MONTANA FORESTS (MBF)***




Source: Montana Department of Natural Resources, Forest Management Bureau

*TABLE H-5 - THREE CREEKS TIMBER SALE PROJECT DIRECT EMPLOYMENT AND INCOME IMPACTS*

| | ALTERNATIVE | | | |
|---|---|---|---|---|
| | B | C | D | E |
| Direct employment | 252 | 241 | 273 | 254 |
| Wages and salaries | $9,779,600 | $9,350,200 | $10,610,400 | 9, 860,600 |

the timber industry is spent to purchase goods and services elsewhere in the economy. Impacts also occur when logging companies and timber mills purchase goods and services from the local economy. Both of these effects are important since they support other community businesses, such as grocery stores, clothing stores, gas stations, etc. The loss of income from this sale would mean not only the loss of direct income, but the loss of indirect income as well.

The economic impact on schools occurs through ways other than just the direct contribution to the school trust fund from revenue generated through timber sales. Taxes are paid on the facilities the wood industry owns and operates. In the year 2000, the wood industry paid taxes of nearly $1,914,000 to the schools in Flathead, Lake, and Missoula counties. The tax contribution will decline in the future if mill closures, such as American Timber Company in Flathead County, continue. This closure reduced the tax base by an estimated $4.4 million, thereby reducing the taxes received by the school districts by about $28,500. This is a permanent reduction in school funding for over 5 students per year.

*INDIRECT EFFECTS*

- ***Indirect Economic Effects of No-Action Alternative A***

None of the indirect effects that would result from the action alternatives would occur.

- ***Indirect Economic Effects of Action Alternatives B, C, D, and E***

Indirect economic impacts are much broader than those identified under *DIRECT EFFECTS*, above. Some of these impacts are the result of the money from the sales "recycling" through the economy several times. For example, the money spent for groceries by the employee of the timber mill, in part, goes to pay the salary of the grocery store employee, the grocery store employee's use that money to purchase groceries for themselves. This, in turn, generates more income for the grocery store employees, etc. Unfortunately, a model of the county that could be used to demonstrate secondary effects is not available. In a broader State-wide context, money paid to wood industry workers results in increased State income-tax collections, as well as increased purchases in other areas of the State. Income-tax collections from the wages of millworkers alone are estimated to generate between $168,000 and $196,000 in State tax revenue, depending on which alternative is selected. Taxes on indirect wages would add to this tax amount. Since the State revenue is spent on projects State-wide, the entire State shares, in part, in the benefits that result from the timber sale. In particular, Montana schools benefit additionally by being able to use these revenues to fund schools throughout the State.

- **Nonmarket Issues**

Quantitative analysis of the economic value of nonmarket benefits and costs will not be

part of this analysis because they do not generate income for the trust, although they do affect the well-being of Montana residents. Because of their effects, a short qualitative discussion of nonmarket issues follows: A brief description of the biological impacts is included in order to identify areas where economic values might be affected. A more detailed discussion of the biological impacts is found in other sections of the report.

- **Environmental Modifications**

  The harvest of timber will modify the undisturbed development of the forest and, as a result, will affect both the short- and long-term habitat and wildlife regimes. How individuals value these modifications is an empirical question and may be viewed either positively or negatively by different individuals. Modifying the undisturbed development of the areas may change the use of the area by some species of wildlife in the short run and may affect the use by other species in the longer term. The estimation of the net social benefit or loss of these impacts is an empirical issue that does not directly affect the school trust fund.

- **Human Use**

  The harvest area has been historically used for recreational purposes such as hiking, hunting, and fishing. While the use of these areas is likely to decline or change during the period of logging, long-term overall use of the area is expected to remain high, and some nonmarket uses are unlikely to change. Fishing, for example, should not be severely affected by the logging since SMZ laws protect streams. The aesthetics will be modified and some individuals will view this as a loss, others may prefer the more-open forest that will result from the harvest. Visual changes are minimized to the extent practicable by limiting the trees harvested in some areas and by "sculpting cuts" to avoid "unnatural" visual lines. Some activities may be enhanced. For instance the logged area may enhance the habitat of some game species, and the increased use of areas by those game species may make the area more attractive to hunters. As in the case of the environmental modifications, the net social benefit or loss is an empirical issue dependent on individual values.

- **Social Impact**

  The area has a substantial presence in the wood-processing industry and, as a result, has institutions established to handle the social requirements associated with this industry. The timber sale is unlikely to add sufficient pressures to these institutions to require their modification. A high rate of employment (low rate of unemployment) is associated with lower rates of crime, domestic violence, alcohol/drug problems, and a healthier, more satisfied community. To the extent that No-Action Alternative A might contribute to unemployment, the harvest might be a short-term negative social impact on the community. Conversely, to the extent that the sale provides employment, the short-term impact will be positive.

- **Roads**

  New roads would be constructed for the sale(s). Existing roads would be improved to handle the logging trucks and provide transport for other equipment used in logging; because of terrain each alternative has a

significant proportion of the sale that will be logged using helicopters. Expenditures for road improvements are identified in each action alternatives as part of the sale development cost. Some improvements are also funded through FI fees, as well as other funds set up for this purpose. To the extent that these expenditures are spent locally, local economic conditions would improve. A portion of the money would leave the area and provide income for other areas of the State and national economies. Culverts, for example, usually come from manufacturers outside of Montana; however, most of the road-improvement expenditures would remain in Montana.

- **Population Impacts**

  Logging and milling activities associated with the timber sale are not anticipated to have any long-term impact on the population of the region or the State of Montana.

- **Underlying Assumptions**

  Project impact estimation and analysis assumes that most of the economic impact associated with the sales will take place in the 3-county area. The estimates are intended for comparative purposes and do not purport to be the value of the impacts in any absolute sense. Stumpage prices were determined using the current transaction equation modified by professional judgment to reflect current and local market conditions as much as possible.

  The FI fee is for a program that provides funding for forest development and improvement and is collected from the logging company as part of their bid. Activities funded under this program include site preparation, tree planting, thinning, roadwork, right-of-way acquisition, etc. The current FI fee for the Northwestern Land Office area is $19.50 per mbf.

  Most of the economic impacts associated with this sale are short term. If no other trees were available for harvest after these sale(s), the tendency would be to return to a lower level of economic activity. A short-term impact that might occur as the local economy contracts might be an increase in unemployment as local employers adjust to the lowered production levels.

### *CUMULATIVE EFFECTS*

- ***Cumulative Economic Effects of No-Action Alternative A***

  No cumulative effects would occur.

- ***Cumulative Economic Effects of Action Alternatives B, C, D, and E***

  This sale would be part of the annual harvest of timber from the State of Montana forested trust lands. The net revenue from this sale would add to the trust fund. Annual trust fund contributions have varied widely over the years, because the actual contribution to the trust is more a function of harvest than of sales. Harvest levels and prices can vary substantially over time; sales volumes tend to be more consistent. *TABLE H-6 -ANNUAL GROSS REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS* shows the annual gross revenue from harvests for the last 5 years. The net contribution to the trust fund is also affected by the annual costs experienced by DNRC for program management, which varies year to year. DNRC should continue to make net annual contributions to the trust from its forest-management program.

  DNRC has a State-wide sustained-yield annual harvest goal of 53.2 mmbf. If timber from this project

is not sold, this volume could come from sales elsewhere; however, the timber may be from other areas and not benefit this region of the State. Long-term deferral of harvest from this forest would impact harvest patterns, changing both the region where the trees are harvested and the volumes taken. The other areas of the State where harvests would occur if this sale is not sold would be impacted.

***TABLE H-6 - ANNUAL GROSS REVENUE FROM TIMBER HARVEST FROM MONTANA FORESTED TRUST LANDS***

| YEAR | HARVEST REVENUE |
|---|---|
| 2005 | $16,596,191 |
| 2004 | $11,043,525 |
| 2003 | $8,278,792 |
| 2002 | $9,686,844 |
| 2001 | $8,524,150 |

*Appendix I*
*Recreation Analysis*

# APPENDIX I
# RECREATION ANALYSIS

## INTRODUCTION

An issue was raised that forest-management activities may conflict with hunting and general recreational use in the area. The Three Creeks Timber Sale Project area currently experiences moderate recreational use by the general public.

## METHODS

The methodologies used to portray the existing condition and determine recreational impacts of the project include determining recreational uses, approximate revenue, and the potential for conflict between project activities and recreational uses.

## ANALYSIS AREA

The analysis area includes all legally accessible lands within the Three Creeks Timber Sale Project area (South Lost, Cilly, and Soup Creek watersheds) and the roads that would be used to haul equipment and logs.

## EXISTING CONDITION

The Three Creeks Timber Sale Project area receives moderate recreational use throughout the year. The area is primarily used for berry and mushroom picking, snowmobiling, cross-country skiing, horseback riding, bicycling, fishing, hiking, hunting, and camping that includes the use of the Soup Creek Campground. The main roads within the sale area that provide recreational access to the Swan Mountains are South Lost Creek, Cilly Creek, and Soup Creek roads.

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There are currently 3 separate outfitting licenses for hunting: 1 each for spring black bear ($700.00 annually), big game ($2,550.00 annually), and mountain lion ($1,850.00 annually). In addition, 6 licenses for fishing outfitters on Swan River are available; 5 are currently in use. The fishing outfitters pay an annual fee of $200.00 each, for a total return of $1,000.00 a year. Finally, there is a cross-country skiing recreational use license ($200.00 annually) and a pending horseback-riding permit. The total annual return on hunting outfitting, fishing outfitting, and recreational use permits is $6,300.00, which, spread across 39,833 acres of Swan River State Forest, is approximately $0.158/acre.

State lands are available for nonmotorized recreational use to anyone purchasing a General Recreational Use License. A recreational fee of two dollars for each user is also obtained through the sale of wildlife conservation licenses required for hunting and fishing in Montana. These two types of licenses and fees are not site specific and allow use of all legally accessible State lands. Therefore, determining the amount of recreational use and income resulting from the sale of licenses for a specific area is difficult. In Fiscal Year 2004, the total gross revenue to the school trust from the General Recreational Use Licenses was approximately $183,660. From March 1 through June 30, 2004, $515,628 in revenue was created under Conservation License sales. As a result, the recreational revenue created totaled $699,288. School trust lands State-wide total 5,160,692 surface acres (*DNRC Annual Report 2004*). Therefore, the average gross revenue is approximately $0.136/acre ($699,288

divided by 5,160,692 acres) for the 2004 fiscal year.

Applying the State-wide average revenue per acre to State land within the project area (approximately 10,640 acres), this land produced estimated revenue of $1,447.04 from General Recreational Use and Conservation licenses, assuming the project area receives an average amount of paid recreational use.

## ALTERNATIVE EFFECTS

### *DIRECT EFFECTS*

- ***Direct Effects of No-Action Alternative A to Recreation***

  Recreational uses and revenue would not change.

- ***Direct Effects of Action Alternatives B, C, D, and E to Recreation***

  Under any action alternative, harvesting activities may temporarily disturb normal game-movement patterns, which may affect hunter success during project implementation. The activities may also briefly affect cross-country skiing and hiking due to increased noise associated with project activities. The harvesting of Unit 27-19, adjacent to Soup Creek Campground, would be planned for winter (November 16 through March 31); thus, no effect to hunting or recreational campground use is anticipated. Finally, Soup Creek Campground will be closed during the winter for a short period to remove hazard trees during project implementation. The winter closure would not be expected to conflict with periods of high use.

  Short delays due to log hauling, snowplowing, and road construction may inconvenience cross-country skiers, snowmobilers, bicyclists, and other recreationists. However, recreational use and revenue income from outfitting, General Recreational Use Licenses, and wildlife conservation licenses are not expected to change with the implementation of this project.

  The status of open, restricted, and closed roads would not change with the implementation of this project.

### *INDIRECT EFFECTS*

- ***Indirect Effects of No-Action Alternative A to Recreation***

  No change is anticipated.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Recreation***

  The amount of recreational use within the project area may change during project implementation. Recreational users may use adjacent areas to avoid harvesting and log-hauling activities. Recreational use and revenue income from Outfitting, General Recreational Use, and Conservation licenses are not expected to change.

### *CUMULATIVE EFFECTS*

- ***Cumulative Effects of No-Action Alternative A***

  Some recreational users may be reluctant to use roads within the project area if roads continue to deteriorate due to the lack of maintenance associated with the commercial activity. However, recreational use and revenue income from Outfitting and General Recreational Use licenses are not expected to change.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Recreation***

  The harvesting and log-hauling activities within the project area may temporarily displace recreational use to areas adjacent to the project area. All levels of existing recreational use on Swan River State Forest are expected to continue. Therefore, revenue income from Outfitting, General Recreational Use, and Conservation licenses are not expected to change.

Appendix J
Air Quality
Analysis

# APPENDIX J
# AIR QUALITY

## INTRODUCTION

During scoping, a concern was expressed that timber harvesting and associated activities may negatively affect air quality. Two specific issues were studied in detail:

- Air quality could be affected by smoke from project-related logging-slash and prescribed burning.
- Air quality may also be affected by road dust created from harvesting and log-hauling activities.

## METHODS

The methodologies used to analyze effects to air quality include estimating the location, amount, and timing of smoke and dust generated by project-related activities.

## ANALYSIS AREA

The analysis area for air quality includes all of Lake County, which is part of Montana Airshed 2 as defined by the Montana/Idaho Airshed Group smoke management program.

## EXISTING CONDITION

Currently, the project area contributes very low levels of air pollution into the analysis area or local population centers. Temporary reductions in air quality from the project area exist in the summer and fall due to smoke generated from prescribed burns on the Flathead Indian Reservation or other upwind sources. Locally, dust is produced by vehicles driving on dirt roads. None of the air-quality reductions affect local population centers beyond EPA standards. The project area lies northwest of the Bob Marshall Wilderness Area, which is a Class 1 airshed. All burning activities by major burners comply with emission levels authorized by the Montana/Idaho Airshed Group.

The project area is outside of the local high population impact zones, where additional restrictions may be imposed to protect air quality.

## ALTERNATIVE EFFECTS

### *DIRECT EFFECTS*

- ***Direct Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Direct Effects Common to Action Alternatives B, C, D, and E to Air Quality***

  Postharvest burning would produce smoke emissions; log hauling and other project-related traffic on dirt roads would increase road dust during dry periods. Members of the smoke monitoring unit pay by the amount of particles released to the atmosphere as measured by the tons of fuel that will be burned. Each alternative may be expected to generate similar amounts of fuel to burn. No increase in emissions is expected to exceed standards or impact local population centers or the Class 1 airsheds that exist to the east within the Bob Marshall Wilderness Area, provided that burning is completed within the requirements imposed by the Montana/Idaho Airshed Group and dust abatement is applied to roads during dry periods.

### *INDIRECT EFFECTS*

- ***Indirect Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Indirect Effects Common to Action Alternatives B, C, D, and E to Air Quality***

  Since emissions are expected to remain within the air-quality standards, no indirect effects to human health at local population centers are anticipated.

*CUMULATIVE EFFECTS*

- ***Cumulative Effects of No-Action Alternative A to Air Quality***

  The existing condition would not change.

- ***Cumulative Effects Common to Action Alternatives B, C, D, and E to Air Quality***

  Additional smoke produced from prescribed burning on adjacent USFS, private industrial forestlands, and State school trust lands would remain within the standards for air quality. The cumulative effects during peak burning periods could affect individuals with respiratory illnesses at local population centers for short durations. All known major burners operate under the requirements of Montana/Idaho Airshed Group, which regulate the amount of emissions produced cumulatively by major burners.

Appendix K
Aesthetics
Analysis

# APPENDIX K
# AESTHETICS ANALYSIS

## INTRODUCTION

In regards to the Three Creeks Timber Sale Project, the concern was raised that forest-management activities may affect aesthetics. The public generally views the project area while sightseeing or recreating.

## ANALYSIS METHODS

The existing conditions and potential impacts to the current views are presented from the perspective of 3 viewing categories. Foreground views include vegetation and topography that are next to roads or trails. Middleground views take in hillsides or drainages from roads and trails. Background views consist of horizons, mountain ranges, or valleys.

The foreground and middleground views are discussed in regard to changes in vegetation, soil, and timber stands along roads. The analysis area for these views is along Soup Creek, Cilly Creek, and South Lost Creek roads as well as various hiking and cross-country skiing trails.

Background views were analyzed based on the openness of the proposed harvest areas and the patterns of trees that would be left in those areas. The analysis area for this view is the central Swan Range on the east side of Swan River State Forest as viewed from Highway 83.

## EXISTING CONDITION

Foreground views along open roads and trails in the project area consist of the immediate landscape up to 200 feet in distance. The foreground views are of open and dense forest stands and openings caused by previous harvesting activities. Firewood gathering and salvage logging have caused some damage to residual live trees; limbs and tops are scattered along skid trails, roads, and ditches.

Middleground views along open roads and trails in the project area are the visible landscape 200 to 1,000 feet in distance, which usually consists of hillsides or drainages. The middleground views are of open and dense multiple-aged forest stands. On State ownership, areas that have been harvested in the past range from 10 to 150 acres and have a dense cover of 6- to 40-foot trees. The old boundaries of harvest units usually follow straight lines and, therefore, appear unnatural.

Background views of the project area are a collection of drainages and ridges that make up a portion of the central Swan Range. The vegetation is a mixture of dense mature forests and past harvest units. Past harvest units range from having few trees to dense retentions of mature trees and abundant tree regeneration. The background landscape of the project area is rarely visible unless viewed from the Soup Creek Road/Highway 83 junction; otherwise, middleground trees obscure visibility for 200 to 1,000 feet.

## ALTERNATIVE EFFECTS

### *DIRECT EFFECTS*

- ***Direct Effects of No-Action Alternative A to Aesthetics***

  Due to lack of forest-management activities, shrubs and trees would continue to grow along the roads and limit views.

- ***Direct Effects of Action Alternatives B, C, D, and E to Aesthetics***

  Treatment methods utilized include commercial thinning, seedtree, seedtree with reserves, shelterwood, and sanitation

(within the Soup Creek Campground). As described in *CHAPTER II - ALTERNATIVES,* the acreage proposed for treatment varies by alternative. These treatments would aesthetically affect the harvest area by:

- opening views;
- causing some damage to the residual vegetation;
- creating logging slash;
- disturbing soil along skid trails and landings;
- constructing new roads; and
- creating temporary landing piles along roads within the project area.

Generally, the foreground views would be altered because fewer residual trees would remain. In portions of the project area, the treatments would allow visibility into the middleground, which would appear altered, more open, and have fewer residual trees. The background views, only visible from the Soup Creek Road/Highway 83 junction, would appear altered and show a variety of tree densities remaining on the landscape.

*INDIRECT EFFECTS*

- ***Indirect Effects of No-Action Alternative A to Aesthetics***

  Aesthetics would not be indirectly affected by this alternative.

- ***Indirect Effects of Action Alternatives B, C, D, and E to Aesthetics***

  For units that would receive seedtree or seedtree-with-reserves harvest treatments, tree density in the affected area would appear similar to the results of a moderately severe fire. For areas of other treatments, the tree density remaining would appear similar to the results of a low-intensity fire of mixed severity. In both scenarios, the species retained will typically be those of early seral stages that would survive these types of fires.

*CUMULATIVE EFFECTS*

The following effects of other projects may influence the cumulative effects of aesthetics on the 3 viewing categories:

1) Environmental processes on the landscape, such as wildfires, windstorms, insect infestations, and disease infections, would continue to alter views over time.
2) Salvage harvesting and firewood gathering would alter the foreground by damaging vegetation along roads and leaving some debris on surfaces of roads and skid trails and in ditchlines. Salvage permits administered by DNRC would keep roadside debris to a minimum. Middleground views would appear altered with fewer trees. Background views would remain largely unaltered due to the minimal size of the salvage harvest areas on the landscape.
3) Previous harvest units of the Goat Squeezer timber sales south of the project area, have resulted in altered views with fewer trees along all 3 viewing categories.

- ***Cumulative Effects of No-Action Alternative A to Aesthetics***

  Cumulative effects would be those described above with no additional impacts from project activities.

- ***Cumulative Effects of Action Alternatives B, C, D, and E to Aesthetics***

  Any of the action alternatives would result in no additional changes to aesthetics, beyond those expected due to environmental processes and other proposed or ongoing projects. Over time, the altered views may be less visible due to natural processes and forest succession.

***Appendix L***

***Scoping Analysis***

# APPENDIX L
# SCOPING AND MAILING LIST

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Appendix M
Glossary

# APPENDIX M
# GLOSSARY

**Acre-foot**
A measure of water or sediment volume equal to an amount of material that would cover 1 acre to a depth of 1 foot.

**Action alternative**
One of several ways of moving toward the project objectives.

**Adfluvial**
A fish that out migrates to a lake as a juvenile to sexually mature and returns to natal stream to spawn.

**Administrative road use**
Road use that is restricted to DNRC personnel and contractors for purposes such as monitoring, forest improvement, fire control, hazard reduction, etc.

**Airshed**
An area defined by a certain set of air conditions; typically a mountain valley where air movement is constrained by natural conditions such as topography.

**Ameliorate**
To make better; improve.

**Appropriate conditions**
Describes the set of forest conditions determined by DNRC to best meet the SFLMP objectives. The 4 main components useful for describing an appropriate mix of conditions are cover-type proportions, age-class distributions, stand-structure characteristics, and the spatial relationships of stands (size, shape, location, etc.); all are assessed across the landscape.

**Background view**
Views of distant horizons, mountain ranges, or valleys from roads or trails.

**Best Management Practices (BMPs)**
Guidelines to direct forest activities, such as logging and road construction, for the protection of soils and water quality.

**Biodiversity**
The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems where they occur.

**Board foot**
144 cubic inches of wood that is equivalent to a piece of lumber 1-inch thick by 1 foot wide by 1 foot long.

**Canopy**
The upper level of a forest consisting of branches and leaves of the taller trees.

**Canopy closure**
The percentage of a given area covered by the crowns, or canopies, of trees.

**Cavity**
A hollow excavated in trees by birds or other animals. Cavities are used for roosting and reproduction by many birds and mammals.

**Centimeter**
A distance equal to .3937 inch.

**Commercial-thin harvesting**
A harvest that cuts a portion of the merchantable trees within a stand to provide growing space for the trees that are retained. For the South Wood Timber Sale Project, thinning would reduce stand densities to approximately 100 trees per acre

**Compaction**
The increase in soil density caused by force exerted at the soil surface, modifying aeration and nutrient availability.

**Connectivity**
The quality, extent, or state of being joined; unity; the opposite of fragmentation.

**Core area**
See Security Habitat (grizzly bears).

**Cover**
See HIDING COVER and/or THERMAL COVER.

**Coarse down woody material**
Dead trees within a forest stand that have fallen and begun decomposing on the forest floor.

**Crown cover or crown closure**
The percentage of a given area covered by the crowns of trees.

**Cull**
A tree of such poor quality that it has no merchantable value in terms of the product being cut and manufactured.

**Cumulative effect**
The impact on the environment that results from the incremental impact of the action when added to other actions. Cumulative impacts can also result from individually minor actions, but collectively they may compound the effect of the actions.

**Direct effect**
Effects on the environment that occur at the same time and place as the initial cause or action.

**Ditch relief**
A method of draining water from roads using ditches and a corrugated metal pipe. The pipe is placed just under the road surface.

**Dominant tree**
Those trees within a forest stand that extend their crowns above surrounding trees and capture sunlight from above and around the crown.

**Drain dip**
A graded depression built into a road to divert water and prevent soil erosion.

**Ecosystem**
An interacting system of living organisms and the land and water that make up their environment; the home place of all living things, including humans.

**Embeddeness**
Embeddedness refers to the degree of armour or the tight consolidation of substrate.

**Environmental effects**
The impacts or effects of a project on the natural and human environment.

**Equivalent clearcut area (ECA)**
The total area within a watershed where timber has been harvested, including clearcuts, partial cuts, roads, and burns.

*Allowable ECA* - The estimated number of acres that can be clearcut before stream-channel stability is affected.

*Existing ECA* - The number of acres that have been previously harvested taking into account the degree of hydrologic recovery that has occurred due to revegetation.

*Remaining ECA* -The calculated amount of harvesting that may occur without substantially increasing the risk of causing detrimental effects to stream-channel stability.

**Excavator piling**
The piling of logging residue (slash) using an excavator.

**Fire regimes**
Describes the frequency, type, and severity of wildfires. Examples include: frequent, nonlethal underburns; mixed-severity fires; and stand-replacement or lethal burns.

**Fluvial**
A fish that outmigrates to a river from its natal stream as a juvenile to sexually mature in the river, and returns to its natal stream to spawn.

**Forage**
All browse and nonwoody plants available to wildlife for grazing.

**Foreground view**
The view immediately adjacent to a road or trail.

**Forest improvement (FI)**
The establishment and growing of trees after a site has been harvested. Associated activities include:

- site preparation, planting, survival checks, regeneration surveys, and stand thinnings;
- road maintenance;
- resource monitoring;
- noxious weed management; and
- right-of-way acquisition on a State forest.

**Fragmentation (forest)**
A reduction of connectivity and an increase in sharp stand edges resulting when large contiguous areas of forest with similar age and structural characteristics are interrupted through disturbances, such as stand-replacement fires and timber stand harvesting.

**Geomorphological processes**
The observed proportions of habitat types for each reach are within the broad ranges of expected conditions.

**Habitat**
The place where a plant or animal naturally or normally lives and grows.

**Habitat type**
Land areas that would produce similar plant communities if left undisturbed for a long period of time.

**Harvest units**
Areas of timber proposed for harvesting.

**Hazard reduction**
The abatement of a fire hazard by processing logging residue with methods such as separation, removal, scattering, lopping, crushing, piling and burning, broadcast burning, burying, and chipping.

**Hiding cover**
Vegetation capable of hiding 90 percent of a standing adult mammal from human view at a distance of 200 feet.

**Historical forest condition**
The condition of the forest prior to settlement by Europeans.

**Indirect effects**
Secondary effects that occur in locations other than the initial action or significantly later in time.

**Intermediate trees**
Characteristics of certain tree species that allow them to survive in relatively low-light conditions, although they may not thrive.

**Interdisciplinary team (ID Team)**
A team of resource specialists brought together to analyze the effects of a project on the environment.

**Landscape**
An area of land with interacting ecosystems.

**McNeil Coring**
McNeil coring is a method used to determine the size range of material in streambed spawning sites.

**Meter**
A distance equal to 39.37 inches.

**Middleground view**
The view that is 200 to 1,000 feet from a road or trail, usually consisting of hillsides and drainages.

**Millimeter**
A distance equal to .03937 inch.

**Mitigation measure**
An action or policy designed to reduce or prevent detrimental effects.

**Multistoried stands**
Timber stands with 2 or more distinct stories.

**Nest site area (bald eagle)**
The area in which human activity or development may stimulate the abandonment of the breeding area, affect successful completion of the nesting cycle, or reduce productivity. It is either mapped for a specific nest, based on field data, or, if that is impossible, is defined as the area within a ¼-mile radius of all nest sites in the breeding area that have been active within the past 5 years.

**No-action alternative**
The option of maintaining the status quo and continuing present management activities by not implementing the proposed project.

**Nonforested area**
A naturally occurring area, (such as a bog, natural meadow, avalanche chute, and alpine areas) where trees do not establish over the long term.

**Old growth**
*Working definition* - Old growth as defined by *Green et al.*

*Conceptual definition* - The term old growth is sometimes used to describe the later, or older, stages of natural development of forest stands. Characteristics associated with old-growth generally include relatively large old trees that contain a wide variation in tree sizes, exhibit some degree of a multi-storied structure, have signs of decadence, such as rot and spike-topped structure, and contain standing large snags and large down logs.

**Old-growth network**
A collection of timber stands that are selected to meet a management strategy that would retain and recruit 150+-year-old stands over the long term (biodiversity, wildlife, the spatial arrangement of stands and their relationship to landscape patterns and processes) are elements that are considered in the selection of stands.

**Overstory**
The level of the forest canopy that include the crowns of dominant, codominant, and intermediate trees.

**Patch**
A discrete (individually distinct) area of forest connected to other discrete forest areas by relatively narrow corridors; an ecosystem element (such as vegetation) that is relatively homogeneous internally, but differs from what surrounds it.

**Potential nesting habitat (bald eagle)**
Sometimes referred to as 'suitable nesting habitat', areas that have no history of occupancy by breeding bald eagles, but contain potential to do so.

**Project file**
A public record of the analysis process, including all documents that form the basis for the project analysis. The project file for the South Wood Timber Sale Project EIS is located at the Swan River State Forest headquarters office at Goat Creek.

**Redds**
The spawning ground or nest of various fish species.

**Regeneration**
The replacement of one forest stand by another as a result of natural seeding, sprouting, planting, or other methods.

**Reinitiation**
The first phase of the process of stand development.

**Resident**
Pertaining to fish, resides and reproduces in natal stream.

**Residual stand**
Trees that remain standing following any cutting operation.

**Road-construction activities**
In general, "road-construction activities" refers to all activities conducted while building new roads, reconstructing existing roads, and obliterating roads. These activities may include any or all of the following:

- constructing road
- clearing right-of-way
- excavating cut/fill material
- installing road surface and ditch drainage features
- installing culverts at stream crossings
- burning right-of-way slash
- hauling and installing borrow material
- blading and shaping road surfaces

**Road improvements**
Construction projects on an existing road to improve the ease of travel, safety, drainage, and water quality.

**Saplings**
Trees 1.0 inches to 4.0 inches in dbh.

**Sawtimber trees**
Trees with a minimum dbh of 9 inches.

**Scarification**
The mechanized gouging and ripping of surface vegetation and litter to expose mineral soil and enhance the establishment of natural regeneration.

**Scoping**
The process of determining the extent of the environmental assessment task. Scoping includes public involvement to learn which issues and concerns should be addressed and the depth of the assessment that will be required. It also includes a review of other factors such as laws, policies, actions by other landowners, and jurisdictions of other agencies that may affect the extent of assessment needed.

**Security**
For wild animals, the freedom from the likelihood of displacement or mortality due to human disturbance or confrontation.

**Security habitat (grizzly bears)**
An area of a minimum of 2,500 acres that is at least 0.3 miles from trails or roads with motorized travel and high-intensity, nonmotorized use during the nondenning period.

**Seedlings**
Live trees less than 1.0 inch dbh.

**Seedtree harvesting**
Removes all trees from a stand except for 6 to 10 seed-bearing trees per acre that are retained to provide a seed source for stand regeneration.

**Sediment**
Solid material, mineral or organic, that is suspended and transported or deposited in bodies of water.

**Sediment yield**
The amount of sediment that is carried to streams.

**Seral**
Refers to a biotic community that is in a developmental, transitional stage in ecological succession.

**Shade intolerant**
Describes tree species that generally can only reproduce and grow in the open or where the overstory is broken and allows sufficient sunlight to penetrate. Often these are seral species that get replaced by more shade-tolerant species during succession. In Swan River State Forest, shade-intolerant species generally include ponderosa pine, western larch, Douglas-fir, western white pine, and lodgepole pine.

**Shade tolerant**
Describes tree species that can reproduce and grow under the canopy in poor sunlight conditions. These species replace less shade-tolerant species during succession. In Swan River State Forest, shade-tolerant species generally include subalpine fir, grand fir, Douglas-fir, Engelmann spruce, western hemlock, and western red cedar.

**Sight distance**
The distance at which 90 percent of an animal is hidden from view by vegetation.

**Silviculture**
The art and science of managing the establishment, composition, and growth of forests to accomplish specific objectives.

**Site Preparation**
A hand or mechanized manipulation of a harvested site to enhance the success of regeneration. Treatments are intended to modify the soil, litter, and vegetation to create microclimate conditions conducive to the establishment and growth of desired species.

**Slash**
Branches, tops, and cull trees left on the ground following harvesting.

**Snag**
A standing dead tree or the portion of a broken-off tree. Snags may provide feeding and/or nesting sites for wildlife.

**Spur roads**
Low-standard roads that are constructed to meet minimum requirements for harvesting-related traffic.

**Stand**
An aggregation of trees that are sufficiently uniform in composition, age, arrangement, and condition and occupy a specific area that is distinguishable from the adjoining forest.

**Stand density**
Number of trees per acre.

**Stocking**
The area of a piece of land that is now covered by trees is compared to what could ideally grow on that same area. The comparison is usually expressed as a percent.

**Stream gradient**
The slope of a stream along its course, usually expressed in percentage, indicating the amount of drop per 100 feet.

**Stumpage**
The value of standing trees in the forest. Sometimes used to mean the commercial value of standing trees.

**Substrate scoring**
Rating of streambed particle sizes.

**Succession**
The natural series of replacement of one plant (and animal) community by another over time in the absence of disturbance.

**Suppressed**
The condition of a tree characterized by a low-growth rate and low vigor due to overcrowding competition with overtopping trees.

**Texture**
A term used in visual assessments indicating distinctive or identifying features of the landscape depending on distance.

**Thermal cover**
For white-tailed deer, thermal cover has 70 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller. For elk and mule deer, thermal cover has 50 percent or more coniferous canopy closure at least 20 feet above the ground, generally requiring trees to be 40 feet or taller.

**Timber-harvesting activities**
In general, all the activities conducted to facilitate timber removal before, during, and after the timber is removed. These activities may include any or all of the following:

- felling standing trees and bucking them into logs
- skidding logs to a landing
- processing, sorting, and loading logs at the landing
- hauling logs to a mill
- slashing and sanitizing residual vegetation damaged during logging
- machine piling logging slash
- burning logging slash
- scarifying, preparing the site as a seedbed
- planting trees

**Understory**
The trees and other woody species growing under a, more-or-less, continuous cover of branches and foliage formed collectively by the overstory of adjacent trees and other woody growth.

**Uneven-aged stand**
Various ages and sizes of trees growing together on a uniform site.

**Ungulates**
Hoofed mammals, such as mule deer, white-tailed deer, elk, and moose, that are mostly herbivorous and many are horned or antlered.

**Vigor**
The degree of health and growth of a tree or stand.

**Visual screening**
The vegetation that obscures or reduces the length of view of an animal.

**Watershed**
The region or area drained by a river or other body of water.

**Water yield**
The average annual runoff for a particular watershed expressed in acre-feet.

**Water-yield increase**
An increase in average annual runoff over natural conditions due to forest canopy removal.

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## ACRONYMS

| | |
|---|---|
| ARM | Administrative Rules of Montana |
| BMP | Best Management Practices |
| CEA | Checklist Environmental Assessment |
| dbh | diameter at breast height |
| DEIS | Draft Environmental Impact Statement |
| DEQ | Department of Environmental Quality |
| DFWP | Montana Department of Fish, Wildlife, and Parks |
| DNRC | Department of Natural Resources and Conservation |
| ECA | Equivalent Clearcut Acres |
| EIS | Environmental Impact Statement |
| EPA | Environmental Protection Agency |
| FBC | Flathead Basin Commission |
| FEIS | Final Environmental Impact Statement |
| FI | Forest Improvement |
| FM | Forest Management |
| FNF | Flathead National Forest |
| FY | Fiscal Year (July 1 - June 30) |
| FOGI | Full Old-Growth Index |
| GIS | Geographic Information System |
| ID Team | Interdisciplinary Team |
| MBTRT | Montana Bull Trout Restoration Team |
| MBTSG | Montana Bull Trout Scientific Group |
| MCA | Montana Codes Annotated |
| MEPA | Montana Environmental Protection Act |
| MMBF | Million Board Feet |
| MNHP | Montana Natural Heritage Program |
| NWLO | Northwestern Land Office |
| RMZ | Riparian Management Zone |
| Rules | Administrative Rules for Forest Management |
| SFLMP | State Forest Land Management Plan |
| SLI | Stand-level Inventory |
| SMZ | Streamside Management Zone |
| SVGBCA | Swan Valley Grizzly Bear Conservation Agreement |
| TMDL | Total Maximum Daily Load |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |

| | |
|---|---|
| 124 Permit | Stream Preservation Act Permit |
| 318 Authorization | A short-term Exemption from Montana's Surface Water Quality and Fisheries Cooperative Program |
| Land Board | Board of Land Commissioners |

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